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AMERICAN MUSEUM NOVITATES

Number 641-68 ✓
Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

June 30, 1933

1933
59.57, 99 T:11.856

EXPERIMENTS WITH "STINGLESS BEES" (*TRIGONA CRESSONI PARASTIGMA*) CONCERNING THEIR ABILITY TO DISTINGUISH ULTRAVIOLET PATTERNS

BY FRANK E. LUTZ

Several years ago it was demonstrated¹ that many flowers reflect the ultraviolet of sunlight and, so, have an ultraviolet color in the eyes of any creature that can see ultraviolet, just as many flowers reflect the blue of sunlight and, so, have a blue color in our eyes. It was also shown that all of the flower-visiting insects that were tested could see the ultraviolet of sunlight transmitted through a filter that cut out that part of the spectrum which is visible to us. More recently it has been found² that many butterflies and moths have ultraviolet color-patterns. Accordingly, a better knowledge concerning the ability of insects to distinguish ultraviolet color and color-patterns is highly desirable.

The experiments with flower-visiting insects were conclusive as to the ability of those insects to perceive and react to ultraviolet, but the experiments did not show that the insects differentiate ultraviolet in their natural environment and react to it in a normal way. The apparatus used was a box into which the insects were placed and from which they tried to escape through one or more windows screened with light-filters. Presumably they would try hardest at the window which looked brightest to them and that was the window which transmitted the ultraviolet of sunlight but which looked dark to us because it did not transmit the light visible to us.

The Von Frisch school of experimentalists in Munich has secured exceptionally interesting results³ concerning a variety of points in the psychology and physiology of the domestic bee, *Apis mellifera*. The principal method of procedure has been to accustom honey-bees to come to a definite place for honey or sweetened water and then to associate with that food some color or pattern or whatever was being studied.

¹Lutz, F. E., and Richtmyer, F. K., 1922, *Science*, LV, May 12. Richtmyer, F. K., 1923, *Journ. Optical Soc. Amer.*, VII, pp. 151-168. Lutz, F. E., 1924, *Annals New York Acad. Sci.*, XXIX, pp. 233-279.

²Lutz, F. E., and Burlingame, R., 1932, Report, as yet unpublished, at the Atlantic City meeting of the Entomological Society of America.

³See, for example, Baugartner, H., 1928, 'Der Formensinn und die Schachkarte der Bienen,' *Zeit. f. Verg. Physiol.*, VII, pp. 56-143.

After a short period of training in this association the bees were tested in order to discover how accurately they could distinguish the associated thing from things not thus associated.

Anticipating a short stay at the Barro Colorado Island Laboratory of the Institute for Research in Tropical America, I prepared to try the same technique with one or more of the several species of *Trigona* that are fairly abundant there, largely to see if they furnished good material for such work but also hoping that at least some information might be obtained concerning the reactions of a completely feral species in its natural environment to ultraviolet color.

These *Trigona* belong to the tropical family Meliponidae, the so-called Stingless Bees. They are social but are apparently not very closely related to our common honey-bee, an Asiatic species of the family Apidae. Much to my surprise, I found, when attempting to start the work, that the *Trigona* then present in the Laboratory clearing paid no attention to sweetened water, even when it was placed close to their nest-opening. I tried both refined, white sugar and the native, very brown kind; also honey, maple syrup, sweetened orange syrup, grenadine, and ripe fruits. Knowing that certain species eat meat to some extent, I tried that, lard, and other substances without success. The only thing that I found to interest any of the bees at that time and place was fecal matter. They collect such excrement, probably for use in nest-building. However, this attractant is neither pleasant nor convenient to use.¹ Therefore, I took the somewhat desperate chance of bees forming an association between nest and color or color-pattern that would be stronger than their sense of nest-location based on other environmental features.

There was a colony of *Trigona cressoni parastigma* that had its nest in a wall of the laboratory building. The bees used a part of the space between the adjoining ends of two boards as a passage-way to and from the nest. There was no nest-entrance "funnel" such as is frequent on *Trigona* nests but, except for about 15 mm. used as a passage-way, the space between the boards was neatly filled with a black, waxy mixture flush with the surface of the boards. As was to be expected, most of the bees flew directly away from and to this nest-entrance as though its position on the side of the building were well-marked and thoroughly known. From time to time one or more bees, probably young ones, flew back and forth a meter or so from the building as though making

¹As a matter of fact, experiments were started with excrement as an attractant for *Trigona pallida* but they were not carried to any definite conclusion. Also, several days before the end of my stay a swarm of *Trigona testacea cupira* moved into the Laboratory clearing and individuals of this swarm were attracted to sugar and fruits.

"orientation observations." The principal large objects by which they might orient themselves were a vertical water-pipe two or three meters to the left and a flight of outside stairs about the same distance to the right of the nest entrance.

Experiments with a large variety of Hymenoptera have shown how remarkably exact is their knowledge of the location of their nest. In some cases the fact that small objects in the immediate vicinity of a nest are used as "markers" is shown by the confusion caused by disturbing these objects. In other cases it appears that more general features of the nest's environment are used or else—less probable—that some mysterious "location sense" is involved. For example, if the hive of a colony of *Apis mellifera* be moved only a few centimeters, the bees that were absent when the shift occurred will return to the old location although the hive is probably plainly visible to them and might be expected to act as an important landmark.

In the Munich experiments on the vision of *Apis* the dish or box containing the attractant could be moved every few minutes so that the bees formed no definite location association. This, of course, was impossible with the *Trigona* when using the nest itself as the attractant. This condition proved to be a real difficulty but the results obtained seem to be all the more conclusive because of it.

Another desirable feature of the Munich experiments that could not be incorporated in the present ones was the marking of individual bees so that the observer might know which had been subjected to "training" and for how long. When food is used as an attractant, it can be so arranged that only a few individual bees are concerned. Here we had the whole colony, including those which matured during the course of the work.

The plan of the present experiments was to place a color or color-pattern around the nest opening with contrasting colors or color-patterns in its immediate vicinity. Naturally, the position of the nest-marking color or color-pattern could not be shifted during the time that the bees were being "trained" to associate it with their nest-opening. However, the positions of the other colors or color-patterns were shifted frequently—usually every hour. This was done in an attempt to prevent, so far as possible, the bees from associating the location of their nest with the positions of the colored discs in general.

In order to facilitate the shifting of the colored cards, folders of heavy Manila paper were made to contain them. The folders were about ten centimeters square. There was a circular hole about fourteen millimeters

in diameter in the center of each colored card and in the back of each folder. There was also a centered circular hole about six and a quarter centimeters in diameter in the front of each folder, exposing the colored card. By an arrangement of strings these folders with the enclosed cards could be hung against the side of the building.

For the sake of easy reference a "map" of the nest-vicinity was divided into squares and lettered as shown in figure 1. "M" was the nest-opening square. When a folder and its contained card was placed,

A	B	C	D	E
F	G	H	I	J
K	L	<u>M</u>	N	O
P	R	S	T	U
V	W	X	Y	Z

Fig. 1.—A "map" of the spaces upon which experimental patterns were placed.

on M, the nest-opening showed as a vertical black streak in the central hole of the card. Accordingly, a black streak was painted on the side of the house wherever a folder with its card was to be hung.

TRAINING IN ASSOCIATING COLOR-PATTERN WITH NEST-LOCATION

In order to determine whether these bees would reasonably soon come to associate the location of their nest with an at least striking color-pattern as opposed to an equally striking, but different, color-pattern and other features of the nest's vicinity, I put *d* of figure 2 at the nest opening (space M). This pattern consists of four black sectors and alternating with them four white sectors that reflect ultraviolet—that is, are ultraviolet in addition to the colors we see. Pattern *a* of figure 2

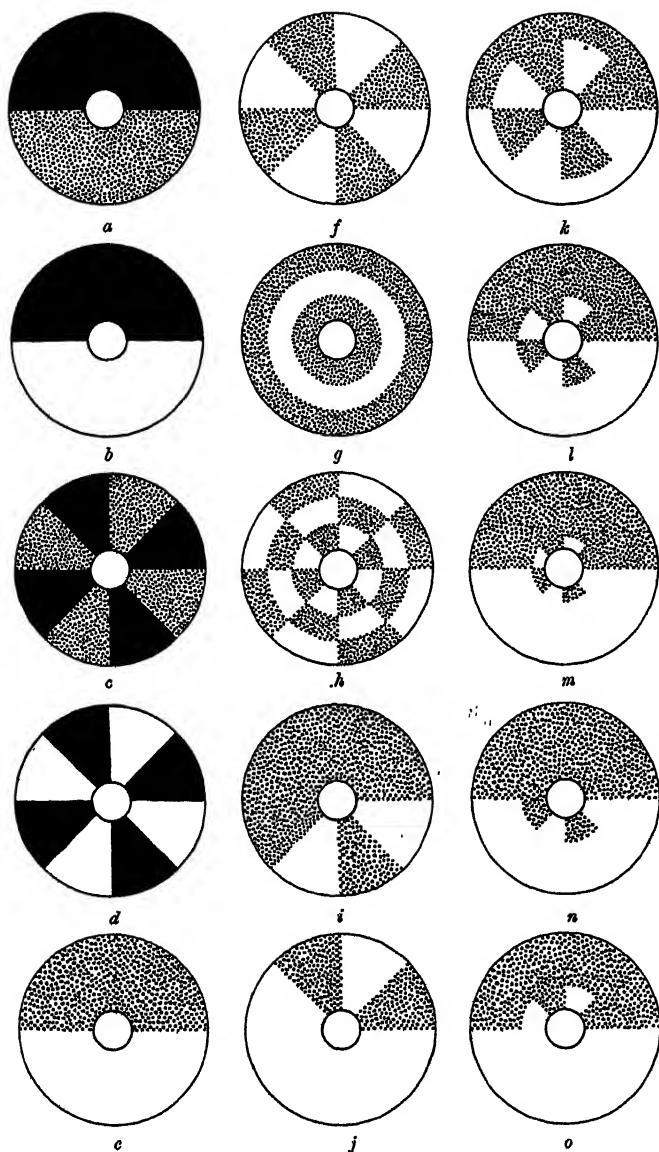


Fig. 2. Diagrams of patterns used. Stippled areas were white with little or no ultraviolet. Unshaded areas were white reflecting ultraviolet.

was used in contrast with it. This pattern consists of a semicircle of black above; below is a semicircle of white (Chinese White) that does not reflect ultraviolet.

Starting at 1:45 P.M., March 4, there was a folder with a *d* card at M (the nest) and folders with *a* cards at H and N. At 8:00 A.M. the next day the folders with *a* cards were moved to G and L, and at 11:00 A.M. to S and T. It will be noted by reference to figure 1 that in each of these arrangements the three cards, taken together, formed a right angle like the letter L and that the shifts brought the nest opening successively to each of the three relative positions in the "L."

It is difficult to tabulate or even to describe in a few words the behavior of the incoming bees. This difficulty is of importance when scoring the "tests" in which the nest-marking pattern is put where the nest-opening is not. Under normal conditions the bees may go directly to the opening, usually sweeping more or less upward from below, or they may hover about half a meter in front of it before darting in. Under the artificial conditions of this experiment when a bee mistook the central hole of an *a* card for its nest-opening, it might discover its error before actually alighting. In that case it usually flew back a bit and tried again, often at the same card. Such darting toward the card, even if not actually alighting, was at first counted as a selection of that card; but, as will be seen, the system of scoring was changed several times in an effort to get a good one.

Starting at 2:00 P.M. (March 5), with the *d* card still at M (the nest opening) and with *a* cards still at S and T, the following selections were made by twenty returning bees, each bee's record being separated by a period and dash: T, T, S, M.—T, M.—M.—M.—S, M.—S, T, M.—M.—S, then flew away.—M.—S, T, S, T, S, M.—T, S, M.—M.—S, M.—M.—M.—T, S, M.—S, S, M.—M.—M.—S, S, T, T, T, M. Of the twenty, 9 went straight to the nest (M with the *d* card); 7 went first to the *a* card on S; and 4 went first to the *a* card on T. Since there were two possibilities of a false choice (the *a* cards on S and T) and only one that was correct (the *d* card on M), the "first choice" of these bees was correct somewhat more often (9 in 20) than it would be (6.7 in 20) if a purely random selection had been made. Of course, having made the correct choice, the bee did not look elsewhere; but if it made a wrong choice, it either tried until the correct one was made or it flew away. The frequent choice of the card on S in this set of observations is not to be explained by its position in relation to the other cards, since the angle of the "L" formation had not recently been the position of the nest. It will

be noted in the records of subsequent observations that a card on S is often favored. Possibly this is because S is just below the nest and in the same vertical line in space.

The position of the cards not having been changed, the choices of another twenty bees were recorded starting at 3:30 P.M. of the same day. They were as follows: M.—S, M.—M.—S, T, M.—M.—T, and away.—M.—M.—S, M.—M.—M.—M.—S, M.—S, M.—M.—M.—M.—M.—M.—M. Of these, M (the *d* card at the nest) was first choice 14 in 20 times, or about twice as often as to be expected in random selection. However, this might mean merely that the bees were learning to look for their nest at the top of the "L" formation of cards.

Accordingly, at 4:00 P.M. the *a* cards were moved to H and N, leaving the *d* card on M, and immediately afterward records were made of twenty returning bees. Sixteen made the correct choice the first time. The four that did not went as follows: N, N, M.—N, N, N, and away.—N, and away.—N, M. The H space was at this time the top of the new "L" formation; and the fact that it was not chosen at all is interesting. Clearly, however, 16 correct first choices in 20, when the random chances are 2 to 1 against such a choice, indicates that either some association had been established between the *d* card and the nest-opening or that the bees had more firmly fixed the relation between the position of the nest-opening and other features of its environment.

The cards were left in this H, M, N formation and at 9:15 A.M. the next day (March 6) previously unused cards were substituted for those which in the preceding day and a half might have acquired some distinctive odor from the bees. Immediately after the change twenty returning bees went directly to the fresh *d* card on M (the nest-opening) with fresh *a* cards in the H and N positions that had been marked with the *a* color-pattern since 4:00 P.M. of the previous day.

However, when at 9:30 I changed the *a* cards to G and L, of twenty returning bees only 5 went to M as first choice and 15 went to L. None went to G at all and only two of those that first went to L repeated that error. Since from 4:00 P.M. of the previous day the correct card had one card above it and one to the right of it, and since, when this arrangement was suddenly changed so that a wrong choice (L) had that position among the three cards, the bees made a first choice of L 15 times in 20, it is clear that they were using as a clue the positions of the cards relative to each other. But, since G was not chosen at all and five correct choices (M) were made, there is an indication of the use of either color or color-pattern as an additional clue.

At 10:30 A.M. the *a* cards were changed to S and T and the behavior of twenty returning bees was recorded. Since there was considerable confusion, the records are given in full: T, M.—M.—S, T, S, M.—S, S, S, S, T, M.—T, S, T, S, T, M.—T, T, T, M.—T, S, M.—T, T, M.—S, S, S, T, S, M.—S, S, S, S and alighted there, T, S, S and alighted, M.—S, T, T, S, T, T, S, M.—S, S, M.—S, S, S and alighted, S, T, M.—S, M.—S, S, S, M.—S, S, T, M.—T, M.—T, T, T, M.—S, T, T, M.—T, T, M. Clearly, in spite of bearing an *a* color-pattern, the favorite choice was S, the card which not only had one above it and one to its right but which was also in the same vertical line in space as the nest.

By 12:55 P.M. the bees had apparently become more accustomed to the arrangement. Of twenty returning bees, 12 went directly to M. The records of the other eight were: T, M.—S, M.—S, T, M.—T, M.—T, T, S, S, M.—S, S, T, M.—T, M.—S, M. The number of correct first choices was well above chance.

At 1:15 P.M. the *a* cards were changed to G and H and immediately afterward twenty returning bees were watched. Of these, 17 went directly to M. The three that did not went as follows: H, G, H, M.—H, M.—G, M. Since the bees had had no time to learn the new arrangement of cards, this is a striking score. It should be noted that, while previously the cards had been arranged so that, looked at as a whole, they formed an "L," in the present arrangement the "L" was reversed and inverted. At 2:55 P.M. with the *a* cards still at G and H twenty bees made the perfect score of going directly to the *d* card at M. This result might be due to an association of the *d* color-pattern with the nest-opening or an orientation with other landmarks or a combination of the two.

It then seemed desirable to have a test in which the color-pattern that had previously marked the location of the nest-opening was placed elsewhere. Accordingly, at 3:15 P.M. a *d* card was placed at Rand *a* cards at L and S, the latter being a favored position, as has been noted. These positions adjoin the nest-position. Both cards and folders were previously unused so that there might be no odor-clue. The first bee to return darted seven times at the *d* card on R before locating the nest-opening. The next bee darted twenty-two times at R and the next one twelve times at the same card. The fourth bee darted at the *d* card on R seven times, then tried the *a* card on S once, and then the *d* card on R twice again before locating the nest-opening. The "dartings" of each of these bees sometimes went so far as to become alightings and searchings for the opening that was not there; but the action was too

rapid for me to make more detailed notes. In fact, when I next tried to make a record of an individual bee, there were five bees at once trying to get into the *d* card at R and in the crowd I lost track of the bee I was watching. Fixing my attention on another, I saw it go to R three times, then to S twice, R three times, S five times, and then to the nest. Another went to R ten times, L once, R twice, and then to the nest. Then two at once were repeatedly trying to get into R before they found the nest. Following these, three more bees did the same thing, frequently alighting in the center of the *d* card at R. This behavior of the bees was continued throughout the fifteen minutes of observation. No instance was noted in which a returning bee did not go first and repeatedly to the *d* card, the color-pattern which had for two days marked the location of their nest but which was now falsely placed.

At 3:30 P.M. a *d* card was replaced at M and *a* cards were placed at L and N, making for the first time a linear arrangement of cards. At 6:30 A.M. the next day (March 7) the *a* cards were shifted to R and T; at 8:30 to G and R; at 9:30 to R and V; at 10:30 to A and G; and at 12:30 P.M. to L and N.

At 1:30 P.M. a test was made in which four color-patterns were used: the *a* and *d* of the previous work and also *b* and *c* of figure 2. The *b* card had the pattern of *a* but the white reflected ultraviolet; the *c* card had the pattern of *d* but the white did not reflect ultraviolet. The *a* card was put on T; the *b* one on R; the *c* one on I; and the *d* one on G. The cards thus surrounded the nest-location but avoided it and also both its vertical and its horizontal line in space. All cards and folders were previously unused. Because of the confusion of many bees hovering in front of this new and complicated arrangement, note-taking was difficult. The *c* card at I was the favorite, with the *d* one at G a fair second, then came the *a* card at T, while the *b* card at R was the least visited of all. Apparently the segmental pattern (*c* and *d*) as contrasted with the semicircular one (*a* and *b*) was associated by the bees with their nest-entrance. This was in accord with their three days of training. On the other hand, they selected the cards on which the white did not reflect ultraviolet (*a* and *c*) more often than those on which it did (*b* and *d*), although the cards that had been marking the site of their nest-opening bore the white that reflected ultraviolet. The reason for this is not clear, but apparently the black-and-"white" patterns impressed the bees more than did the difference in the whites.

At 1:45 a *d* card was replaced at M and *a* cards were placed at H and S. At 2:30 one *a* card was changed from S to T, and at 3:30 another test

was made. In this test only two cards were used: a *c* one at S (a favored position) and a *d* one at R. It is to be noted that the *c* card had a segmental black-and-white pattern like that of *d*, which had been marking the nest-opening, but its white did not reflect ultraviolet. The following are the records of returning bees observed immediately after the cards were placed: R, R, R, R, R, nest.—R, R, S, nest.—R, R, R, R, nest.—R, S, R, nest—Three bees now bunched at R and none at S.—S, S, nest.—S, S, S, nest.—R, R, R, S, R, S, R, nest.—R, R, R and then lost in the mass of bees in front of R.—R, R, R, R, nest. Most of the bees that darted at R alighted one or more times.

It seems that, when there is no difference in pattern, the card on which the white reflected ultraviolet (as it did on the nest-card during training) was associated by the bees with their nest. If this be true, not only can the bees be "trained" to form associations but they can distinguish between patterns and also, the patterns being the same, between white that reflects ultraviolet and white that does not. The following experiment was made in order to test more thoroughly this last point.

DISTINGUISHING ULTRAVIOLET

In this experiment *c* and *d* cards were used. The only certain difference between these cards is that the white of *c* reflected little or no ultraviolet and the white of *d* was tinged with that color. Possibly the bees could detect a difference between the odors, if any, of these paints. Each paint was water color, and to humans neither had an odor. The *d* pattern was still used to mark the nest-opening in order that the training effected in the previous experiment might be of at least some use in this one.

At 3:45 P.M., March 7, a *d* card was placed at M and a *c* one at S. At 4:45 the latter was changed to N. The next day at 6:30 A.M. fresh cards were put out, *d* at M, *c* at L, and another *c* at R. Shifts of *c* cards were made as follows: 8:30 N, S; 9:30, C. H.; 10:30, H. R.; 11:30, R. V; 12:30, T. V; 1:30, I, T; 2:30, G. I; 3:30, I, S; 4:30, H, S; and 5:30, A, G. March 9: 6:30, M, X; 8:30, I, X; 9:30, I, L; and 10:30, I, M.

At 11:05 the *d* card was placed at L and the *c* cards at G and H. The first choice (the card at which a bee darted on its return from foraging) of twenty bees was, without exception, the *d* card at L. At 11:15 the *c* cards were shifted so that one was at H and another at S, the *d* card still being at L. Of twenty "first choices," 16 were the *d* card at L and 4 the *c* card at S, the square which has previously been noted as favored. See figure 3.

At 11:30 training was resumed with the *c* cards at G and N. At 12:45 a demonstration test was made for and with the coöperation of two friends. It happened that the initials of our last names are respectively H, L, and S. Therefore each man was assigned to watch the square corresponding to his initial and each man selected at random a card for his square. Mr. H. got a *d* one and Messrs L. and S., *c* ones. In ten minutes of watching Mr. H. counted twenty first choices of his *d* card, Mr. L. one on his *c* card, and Mr. S. two on his *c* card. Clearly the bees distinguished between the *d* card on which the white reflected ultra-

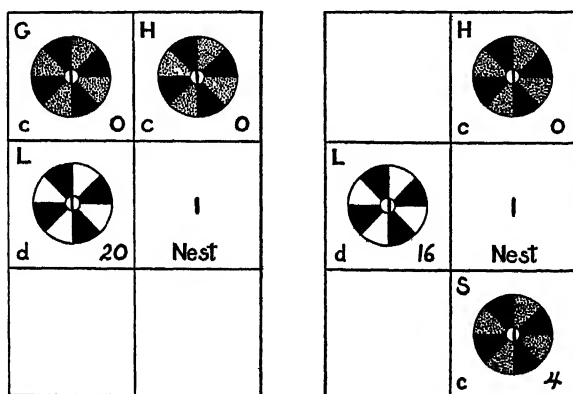


Fig. 3.—Diagrams of two tests involving patterns *c* and *d* (see Fig. 2). Pattern *d* had marked the location of the nest.

violet and the *c* cards on which the white was little or not at all tinged with that color.

People with whom I have discussed this experiment seem prone to slip into the error of thinking that it indicates an attraction of bees to ultraviolet. It does nothing of the kind. There would have been no more difficulty in training the bees to form the opposite association and then, in looking for their nest, they would have avoided ultraviolet. The same error crops up in discussions concerning ultraviolet flowers and flower-visiting insects. Our work did not show that ultraviolet flowers are more attractive. The most that can be said is that ultraviolet is a color to insects just as red is a color to man and as blue is a color to both insects and man. In the following experiment with *Trigona* there was no more ultraviolet on one card than on the other; the cards differed merely in the distribution of that color.

DISTINGUISHING PATTERNS OF WHITE WITH AND WITHOUT ULTRAVIOLET

As my stay in *Trigona* country was to be short, I hastened on to another experiment. The cards used in this were *e* and *f*. These are the same as *b* and *d* respectively except that the black is replaced by a white (Chinese) that reflects little or no ultraviolet (see Fig. 2). To humans the two whites are almost indistinguishable, but by looking closely in a good light we can notice a slight difference in the surface-finish of the two; and the one which reflects ultraviolet is a trifle more cream-colored than the rather chalky Chinese white. It is quite improbable that insect vision is acute enough to perceive the slight difference in texture. The actual differences in humanly visible color-reflection from these paints, as shown by the photometric determinations kindly made by

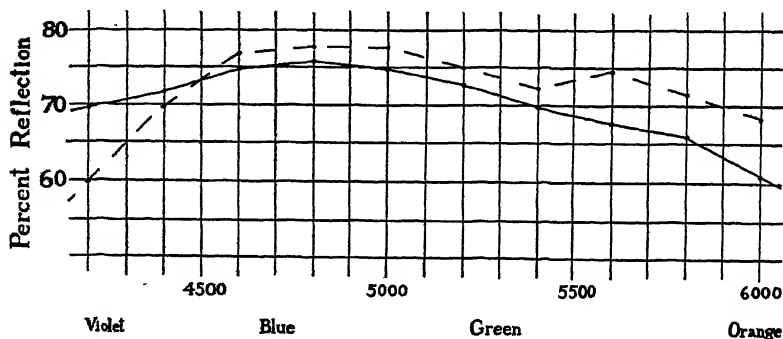


Fig. 4.—Per cent reflection curves between red and ultraviolet of (solid line) the white paint which strongly reflected ultraviolet and (broken line) the white paint which did not.

Mr. E. N. Grisewood, are so slight in the region between red and ultraviolet (see Fig. 4) that they may be dismissed in a discussion involving insect vision. The difference in ultraviolet is indicated by figure 5.

Supposing that either or both paints had an odor which the bees could detect, it would seem unlikely that there was a difference between the cards in odor, since there were equal areas of each kind of paint on each card. However, if the bees can see ultraviolet, the cards as they saw them differed markedly in pattern, *e* consisting of two semi-circles (one strong in ultraviolet; the other not) and *f* consisting of eight segments alternating as to ultraviolet and its absence.

For five days before the starting of this experiment the bees had been under successful training in associating a pattern of alternating

black and white-ultraviolet segments with the location of their nest. Now this training must be counteracted and a new association set up.

Meanwhile, as will appear later, there had been, or was in the process of being, set up another nest-location association: namely, that between the site of the nest and the system of tacks and strings that were used to support the folders and their contained cards, possibly also with other features of the side of the building. It is quite believable that, with the positions of three conspicuous cards constantly shifting in the

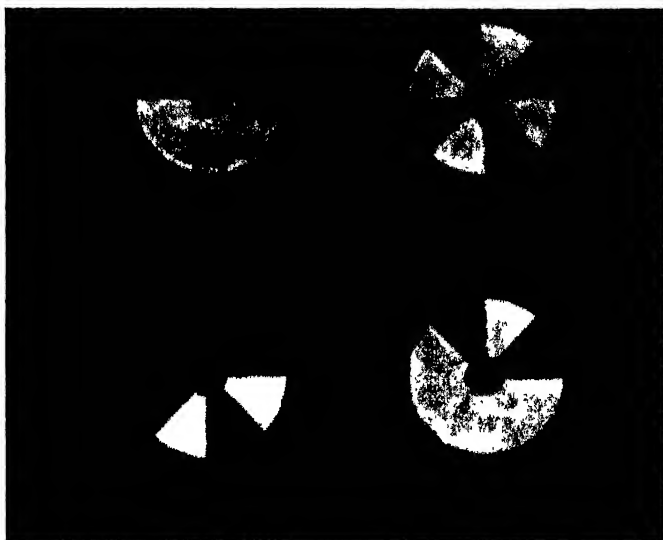


Fig. 5.—A photograph of the all-white patterns *e* and *f* above and *i* and *j* below taken in sunlight through a screen which passed only ultraviolet. The light parts are those areas reflecting ultraviolet.

vicinity of the nest, the bees built up a stronger association between nest-location and less conspicuous but more constant features of the surroundings.

This experiment started at 3:30 p.m., March 9, with an *f* card at the nest (M) and *e* cards at L and S. In what follows, unless the contrary is definitely stated, the *f* card was always at M, the nest-location.

During March 10 the shifts of *e* cards were as follows: 6:45 a.m., G, R; 7:45, G, T; 9:45, S, T; noon, N, T; 1:15, L, N; 3:15, K, L; 4:15, H, S. On March 11 they were: 7:00 a.m., I, L; 8:15, A, V; 8:45,

D, H; 10:00, R, W; 11:00, H, N; noon, N, S; 1:15, L, N; 2:15, K, L; 3:15, N, O; 5:00, N, R. On March 12 they were: 7:00 A.M., G, T; 8:15, T, Z; 9:15, A, G; and 10:15, S, X.

At 11:20, March 12, a test was made with the *f* card at I and the *e* cards at G and S. In this test records were made as accurately as possible of the first definite "dart" at a card made by returning bees. In other words, these records concern the reactions of the bees to the cards as they saw them from a distance of about half a meter. Of twenty bees, 5 darted first at the *f* card on I, 1 at the *e* card on G, and 14 at the *e* card on S. Once again it was evident that there was something about the S location that made it a favorite. Neither G nor I was in line either vertically or horizontally with the nest-opening. Comparing merely G, having an *e* card, with I, having an *f* card, gives an impression that the training to *f* had been at least slightly effective.

The *f* card was then returned to M and the shifting of the *e* cards was continued as follows: 11:40, G, S; 12:30, I, N; 1:30, R, S; 2:30, N, S. At 3:30 a similar test was made with the *f* card at G and the *e* cards at R and T. It will be noted that none of these positions was in either the same vertical or the same horizontal line with the nest. This time there was included in the count the number of bees going directly to the nest, where, during the test, there was no card. Of twenty bees, 12 went directly to the nest, 6 to the *f* card at G, 2 to the *e* card at T, and none to the *e* card at R. Disregarding the clearly strong sense of nest-location and taking into account the fact that there were two *e* cards, the bees seemed to favor the *f* pattern.

The training was then continued with *e* cards shifting as follows: 3:45, V, X; 4:30, C, V; 5:30, A, V. March 13: 6:30, A.M., L, N; 7:30, H, L; 8:30, H, I; 9:30, R, V; 10:30, I, V; 11:30, C, H; 12:30, S, X; 1:40, H, S; and 2:40, L, R.

At 3:00 P.M. March 13, a test was made with fresh cards. An *f* card was placed at G and *e* cards at L and S. Of twenty bees sixteen went directly to the unmarked M, or nest, square; three landed on the *f* card at G; one darted at the *e* card on S; and none at the *e* card on L. The single bee that chose an *e* card went to the one at the favored S square. Three bees going to the single *f* card on an unfavored spot again showed some influence of the training. However, the training was far from complete as was shown when at 3:15 one of the *e* cards was put at M, the other being left at L and the *f* one at G. Of twenty bees, 17 went to M in spite of the *e* card there. Nevertheless, the other 3 went to the *f* card at G and not to the *e* one at L.

This method of scoring leaves much to be desired. It does not take into account the number of bees hovering in front of each of the cards as though inspecting them before either passing on or else darting in to landing. At any instant in the 3:00 P.M. test rather more bees were hovering in front of S than there were in front of either of the other cards, but those individuals that did hover in front of the *f* card at G did so much more persistently. There was very little hovering in front of the *e* card at L.

In order to upset, if possible, whatever it was that was betraying so effectively the position of the nest or, at least, to provide a conspicuous and movable landmark other than the colored cards, the plan was adopted of keeping out nine folders arranged to form a square, three of these folders carrying colored cards and the other six blank. At 4:15 a square of these folders was placed with the corners at G, I, R, and T. An *f* card was put at I and *e* cards at H and L for an immediate test. Once again, of twenty bees, seventeen went first to M, the nest-square now covered, except for the central hole, with a cardless folder. This shows that whatever it was that was guiding the bees to the nest was not masked by the new feature of the nest's surroundings. The other three bees went to the *f* card and there was a very pronounced hovering in front of this but scarcely any in front of either of the two *e* cards.

At 5:45 the square of folders was shifted so that its corners were at B, D, L, and N, bringing the nest-space with an *f* card in the middle of the lower line. The *e* cards were on H and L. The next day, March 14, training was continued with shifts of *e* cards as follows: 7:45, G, H; 8:30, G, I; 9:30, B, H; 10:30, L, N; 11:30, C, I; 12:30, I, N; and 2:00, H, I.

At 2:50 the square of folders was shifted so that the corners were at K, M, V, and X. This gave the W space the same position, relative to the square of folders, that the nest had occupied earlier in the day. K was in the same horizontal line as the nest. R had neither of these advantages and was not in the same vertical line as the nest. An *e* card was placed on each of W and K, and an *f* card was placed on R. The method of scoring was changed so as to take more account of the hovering. In this method I shut my eyes for about five seconds, opened them, quickly noted the positions of bees hovering close to or alighted on cards, then shut my eyes again to repeat the series of observations. Of twenty bees observed in this way, 16 were at the *f* card on R and 2 at each of K and W, the *e* cards. At 3:05 another test was made, using the same method but with an *f* card at W and *e* cards at L and R. This time 13 bees were noted at the *f* card on W, 7 at *e* on R, and 2 at *e* on L. Why

the R space with its *e* card attracted so much attention is not clear unless it was because that had been the position of the *f* card only a few minutes before. At any rate, the *f* card on W received more attention than would be expected on pure chance. The fact that the *f* card did better on the 2:50 test than it did on the 3:05 one, in spite of its apparently better position (with respect to the square of folders) on the second test, may be due to clouds obscuring the sun during the latter test. The bees were called upon to distinguish ultraviolet patterns and quite possibly this is easier in bright sunlight than in dull. Adding the scores of the two tests, the *f* card received 29 and the two *e* cards a total of 13, a ratio of about 4.5:1 in favor of *f*.

The training was then resumed with the folders making the B-D-L-N square and *e* cards shifting as follows: 3:15, H, L; 4:30, C, H. March 15: 8:00, I, L; 9:00, C, L; 9:30, G, I; 10:00, G, N; 11:00, B, G; noon, C, G; 12:30, G, L.

At 1:15 the folders were shifted to cover the square C-E-M-O and fresh cards were used for testing, an *f* one on N and *e* ones on H and I. If the bees had come to use the square of folders as a locality mark, N would be a favored square; and H was in the same vertical line as, but above, the nest. By the method of scoring adopted the day before, N with its *f* card scored fourteen; H, three; and I, one. Then the cards were shifted so that the *f* card was at O and *e* cards at J and N. This time the *f* card scored twenty; the *e* card at N, eighteen; and the *e* card at J, three. Considering only the first of these two tests, one can not say whether N scored so highly because it had the *f* card or because the bees had fixed upon the middle of the lower row (the location of the nest during training; the location of N in the test) of the square of folders as the location of the nest. However, the results of the second test indicate that both of these factors were working.

At 1:40 the folders were placed to cover the square G-I-R-T and training resumed. In this new arrangement of folders the nest-space (M) was the central one. The *e* cards were shifted as follows, *f* still marking the nest: 1:40, N, S; 2:30, L, S; 4:30, R, S. March 16: 7:30 A.M., G, T; 8:10, N, T; 9:00, L, N; 10:15, N, R; 11:00, R, S; noon, H, L; 1:45, I, N; 3:15, I, T. March 17: 7:00, A.M., R, T; 8:00, H, R; 9:30, R, S; 10:00, N, S; 10:50, I, N; noon, H, I; 1:10, I, R; and 2:10, R, S.

At 3:00 P.M., March 17, four *e* and four *f* cards, all previously unused, were put in the folders as shown in figure 6. The nest-opening was closed by a sheet of pasteboard put in the M folder. The scores are shown in the respective spaces. At 3:15 the pasteboard was removed from the

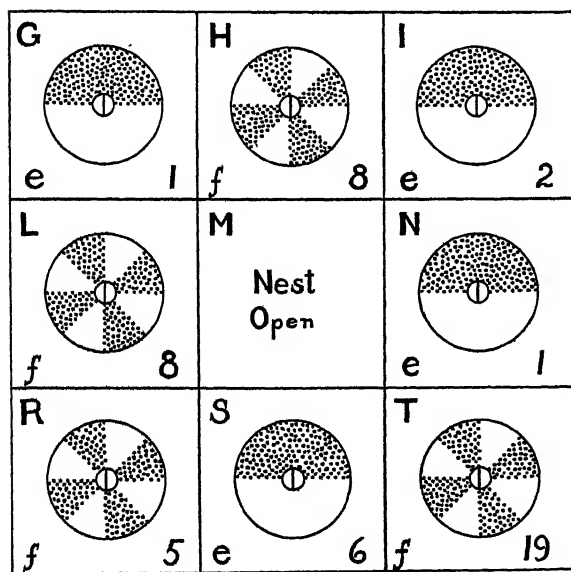
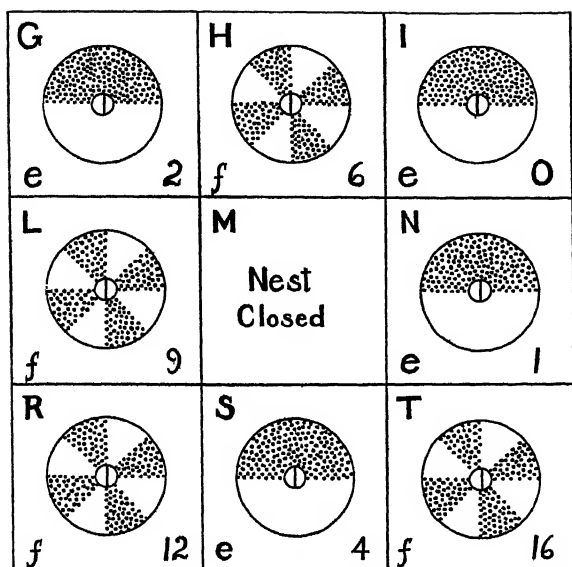


Fig. 6.—Diagrams of two tests involving patterns *e* and *f* (see Figs. 2 and 5). Pattern *f* had marked the location of the nest.

nest-space and the scores recorded as shown in figure 6. There were equal numbers of *e* and of *f* cards so that, disregarding the favored position of the *e* card on S, the random chances were equal that a bee would be at either kind of card. However, there were about five times as many (83:17) at the *f* cards.

Starting at 3:30 a plan was adopted of having *e* cards on each of four, instead of only two, spaces that did not contain the nest. The folders were arranged as before (G-I-R-T) and an *f* card was on M. The *e*

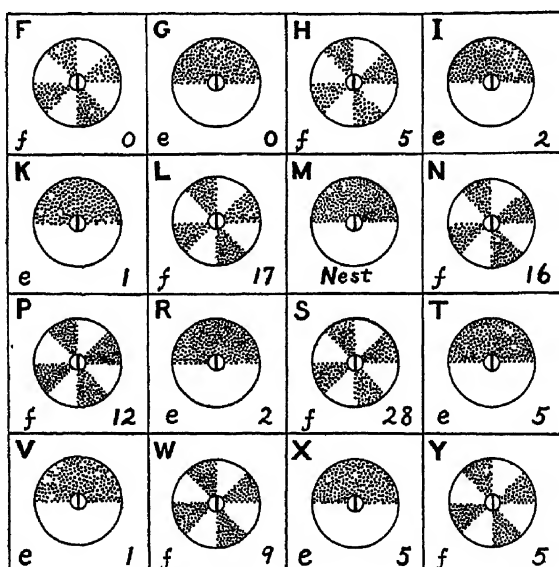


Fig. 7.—Diagram of a test involving patterns *e* and *f* (see Figs. 2 and 5). Pattern *f* had marked the location of the nest.

cards were shifted as follows: 3:30, G, I, N, S. March 18: 7:30, A.M., N, R, S, T; 10:15, G, H, I, L; 2:00, G, H, L, R; 5:00, G, I, R, T. March 19: 8:00 A.M., H, L, N, S; 9:00, L, N, R, T; 10:00, H, I, R, T; 11:30, G, H, I, N; 1:15, G, L, N, T; 2:10, G, L, N, S; and 2:45, H, I, R, S.

Since M, the nest-space, had been in the center of the 3×3 square of folders in the preceding training, the following test was made with a 4×4 square of folders in which no one folder was in the exact center (see Fig. 7). It will be noted that an *e* card was placed at the nest and an *f*

card on S. Most of the bees coming to the *e* card on M hesitated very noticeably before entering and many turned to look elsewhere before doing so. However, once they alighted at M, they were able to go inside and so, being no longer visible, were not counted when scoring that row. Consequently, the M space had better be omitted in considering the scores. This leaves 8 *f*'s to 7 *e*'s; but the *f*'s scored 92 to 16 for the *e*'s, or 5.8:1 instead of the 1.1:1 to be expected on a chance distribution. If we omit the *f* card on S, leaving an equal number of *e*'s and *f*'s, the score was 64 *f*'s to 16 *e*'s, or 4:1 instead of 1:1. This test was made with fresh cards so that no possible odor left by the bees during training would affect the results.

IS THE LOWER PART OF THE PATTERN MORE IMPORTANT THAN THE UPPER?

Training was continued the following day (March 20) in the same manner as before, with the folders making the G-I-R-T square and the *e* cards shifted as follows: 7:00 A.M., G, H, R, T; 8:00, H, L, R, T; 9:00, G, I, R, T; 10:00, H, I, R, S; 11:30, G, H, N, S; 12:30, I, L, N, T; 1:00, G, L, N, S; 1:40, G, L, R, T; and 2:10, H, I, N, S.

Having become confident that the bees could distinguish *e* from *f* and that many of them had been at least partially trained to associate *f* with the nest-opening, I wished to determine whether *Trigona*, like *Apis*,¹ paid more attention to the lower part of a pattern surrounding an entrance-hole (in the case of the *Apis* experiments, the entrance to food) than to the upper part. Accordingly, cards with *i* and *j* patterns (Figs. 2 and 5) were used in a test. In *i* the upper half was the pattern (*e*) that during training had been placed where there was no nest-opening, but the lower half was the *f* pattern that during training had been placed at the space (M) containing the nest-opening. The *j* card was just the reverse, the upper half being the "correct" pattern and the lower half the "wrong" one.

The results (see Fig. 8) were quite striking. Omitting the M score for reasons already stated, the chance distribution of the 110 scores would be *e*, 22.0; *f*, 29.3; *i*, 29.3; *j*, 29.3; but the observed scores were *e*, 3; *f*, 50; *i*, 49; *j*, 8. Both the *f* and the *i* patterns were clear favorites, with *i* doing as well as *f* even though only its lower half had the "correct" pattern and its upper half was "wrong." In fact, the score almost "proves too much" because, if we discount the *f* score because one *f* card was in the favored S position, *i* really did better than *f*.

¹Baumgärtner, *loc. cit.*

If we bear in mind that these scores represent the reactions of a random sample of individuals in a large colony, including "callows" that had emerged since the training started, there seems to be no doubt as to either (1) the ability of the bees to distinguish the to us invisible

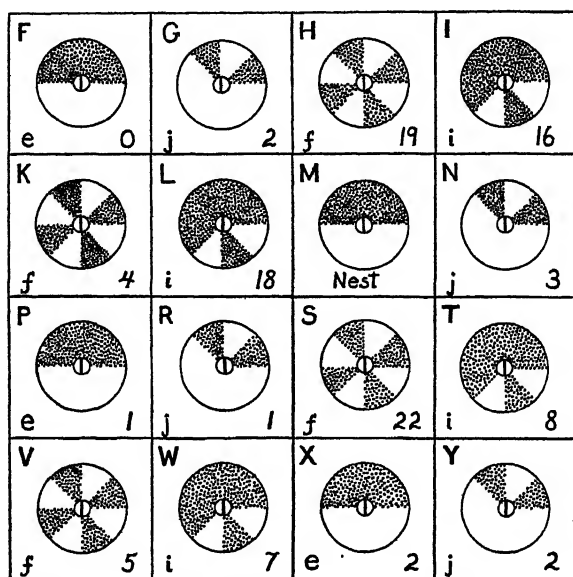


Fig. 8.—Diagram of a test involving patterns *e*, *f*, *i*, and *j* (see Figs. 2 and 5). Pattern *f* had marked the location of the nest.

ultraviolet component of the patterns, or (2) the effect of the training in associating an ultraviolet pattern with such an important feature in their lives as the location of their nest, or (3) that the bees pay attention on alighting (whatever they may do at a distance) only, or at least chiefly, to the lower half of the immediate surroundings of their alighting place.

HOW SMALL AN AREA IS NOTICED BY THE BEES?

Training was continued with the *f* pattern still at the nest but the folders and *e* cards shifted as follows. March 20 (folders: G-I-R-T): 3:50, H, I, R, T; 5:00, L, N, R, T. March 21 (folders: G-I-R-T): 7:00, A.M., H, R, S, T; 8:30, I, L, N, S; 9:30, G, L, N, R; 10:10, G, I, S, T; 11:00, H, N, R, T; 11:30, G, H, I, T; 12:20, G, I, L, R; 1:10,

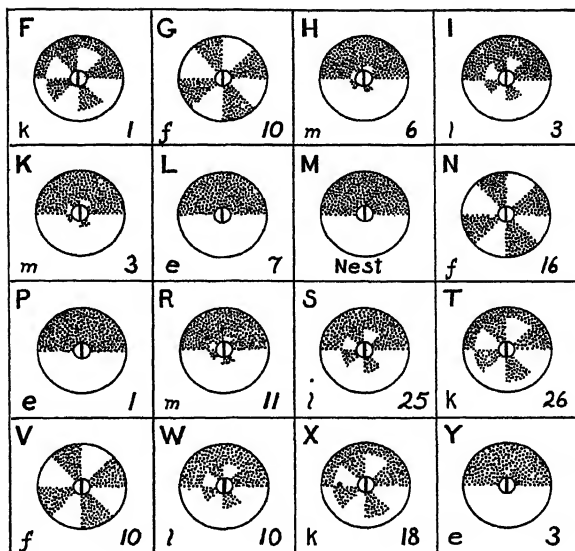


Fig. 9.—Diagram of a test involving patterns *e*, *f*, *k*, *l*, and *m* (see Fig. 2). Pattern *f* had marked the location of the nest.

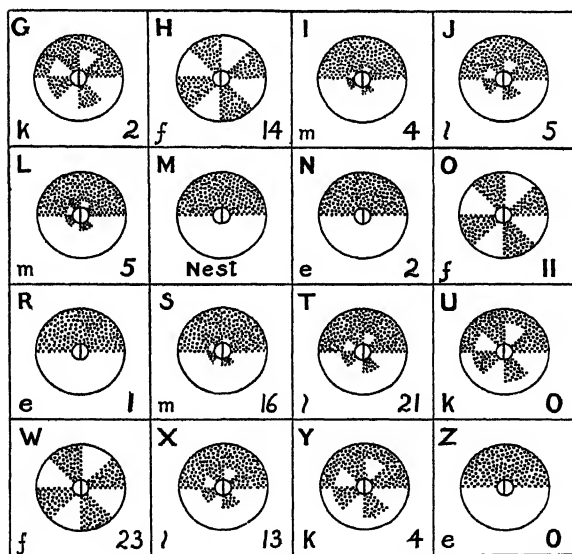


Fig. 10.—Diagram of a test involving patterns *e*, *f*, *k*, *l*, and *m* (see Fig. 2). Pattern *f* had marked the location of the nest.

H, L, N, S; 1:30 (folders, F-H-P-S), H, K, L, S; 2:00 (folders, A-C-K-M), C, H, K, L; 2:30 (folders, C-E-M-O), C, H, I, J.

Then at 3:05, March 21, a test was made with *e*, *f*, *k*, *l*, and *m* patterns (see Fig. 2). The total radius of these patterns was, as before, about 31 mm., and the radius of the central hole was about 7 mm. That is, each card was colored for a distance of about 24 mm. from the edge of the central hole to the outer edge of the pattern. In *k* there was an *f* pattern for 16 mm. from the central hole and then there was an *e* pattern; *l* was the same except that the *f* pattern extended for only 8 mm.; and *m* was the same except that the *f* pattern extended for only about 4 mm. At the time of the test the sky was very cloudy, presumably with the result that there was very little ultraviolet light. The scores are shown in figure 9. Not counting the *e* card at M, there were three cards of each of the five patterns and 150 positions of bees were noted. On the basis of pure chance we might expect about 30 scores for each pattern, but *e* had 11; *f*, 36; *k*, 45; *l*, 38; and *m*, 20.

Training was then continued with the folders forming the G-I-R-T square, *f* on M, and *e* cards shifting as follows. March 21: 3:30, I, L, R, S; 5:00, G, L, N, R. March 22: 7:45, A.M., G, H, L, T; 8:30, G, H, I, S; 9:05, H, I, N, R; 9:40, I, L, N, S; 10:35, G, N, R, T; 11:25, H, L, S, T; 12:25, G, I, R, S; 12:55, H, L, N, R; and 1:30, G, I, L, T.

A second test was made at 1:45, March 22, with better light. The position of folders and cards, also the individual scores, is shown in figure 10. The total scores were *e*, 3; *f*, 48; *k*, 6; *l*, 39; and *m*, 25. Since 121 positions were noted, the expectation on the basis of chance was about 24 for each pattern. Why *k* scored so low is not clear.

Combining the scores of the two tests, we find *e* with 14; *f*, 84; *k*, 51; *l*, 77; and *m*, 45. Apparently *m*, with only the small inner part (a band 4 mm. wide around the central hole) bearing the *f* pattern and all the rest bearing the *e* pattern, was accepted to an appreciable extent by the bees as not being the *e* pattern. Unfortunately, my stay at the Laboratory was then nearly over and I neither determined this point more accurately nor even attempted to determine from what distance the bees discovered that *m* was not *e*.

I did, however, take up patterns *h*, *n*, and *o* (see Fig. 2). The *h* pattern is a combination of *f* and *g*. In *n* the lower half was like the lower half of *l*, but the upper half was like the upper half of *e*. In *o* it was the lower half that was like the corresponding part of *e*, and the upper half was like the upper half of *l*. On the basis of what had gone before it was expected that the bees would to some extent accept *n* as

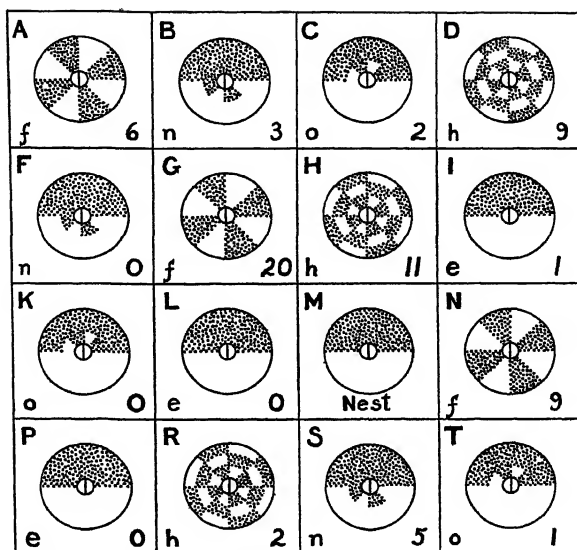


Fig. 11.—Diagram of a test involving patterns, *e*, *f*, *h*, *n*, and *o* (see Fig. 2). Pattern *f* had marked the location of the nest.

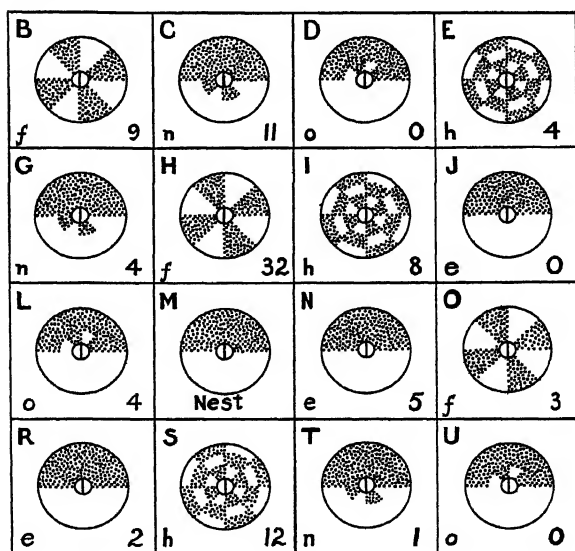


Fig. 12.—Diagram of a test involving patterns *e*, *f*, *h*, *n*, and *o* (see Fig. 2). Pattern *f* had marked the location of the nest.

the pattern marking their nest, because *n* had the *f* pattern for a distance of 8 mm. from the edge of the lower half of the central hole. For a similar reason it was expected that they would not favor *o*. Since *h* was exactly like *f* for some distance around the circular hole and resembled *f* elsewhere it was expected that *h* might be more favored than *n*.

The bees were given a short period of renewed training with the folders covering the M-O-X-Z square, an *f* card on M, and *e* cards shift-

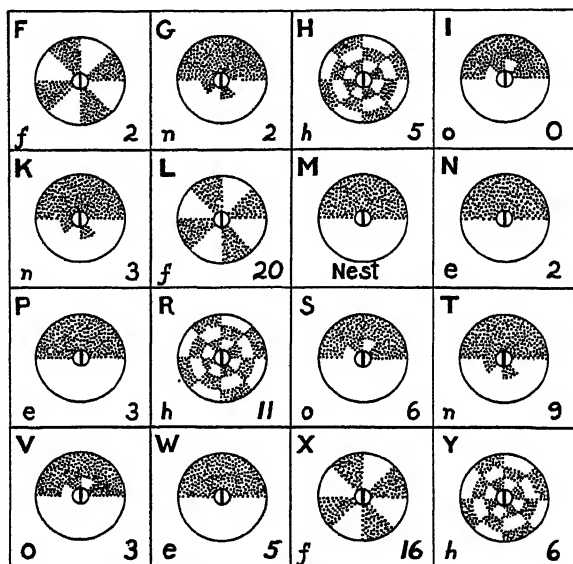


Fig. 13.—Diagram of a test involving patterns *e*, *f*, *h*, *n*, and *o* (see Fig. 2). Pattern *f* had marked the location of nest.

ing as follows. March 22: 2:30, N, S, T, Y; 3:00, O, S, T, Z; 4:30, S, T, Y, Z. March 23: 7:30, N, U, X, Y; and 8:15, N, S, T, U.

Then a test was made at 10:20 and again at 10:40, March 23, with folders, cards, and results as shown in figures 11 and 12. After these tests the folders were put on the B-D-L-N square, and *f* card on M, and *e* cards shifted as follows: 11:00, G, I, L, N; 12:15, C, G, H, I; 1:40, D, H, I, N; and 2:20, B, G, H, L. From 3:00 to 4:00 various simple demonstration tests were made for visitors at the Laboratory and at 4:00 the test diagrammed in figure 13 was made without preliminary training. Adding the results of these three tests together we find that *e* cards scored 18; *f*, 117; *h*, 68; *n*, 38; and *o*, 16.

These results fairly well met expectations, although *f* scored rather more heavily than was anticipated. This strong favoring of *f* so decreased the scores on the other patterns that, in considering them, the comparison should be made with *e*, basing the calculation on the total number less *f*. Possibly the bees, fooled by so many tests, had taken to looking more carefully at the whole pattern from a distance before coming closer.

SUMMARY

The social, tropical bee, *Trigona cressoni parastigma*, could not be induced to come for any of a variety of substances that were offered as food in order to test its ability to form an association between the location of food and some color or color-pattern. However, it was found possible to confuse this bee as to the location of its nest by associating a color or color-pattern with the nest-site and then moving that color or color-pattern elsewhere.

When a pattern of alternating segments of black and white was used, the bee distinguished between white tinged with ultraviolet and white not so colored. It also distinguished patterns made up of white with ultraviolet and white without that color. In the training from March 9 to 23 *f* had marked the site of the nest and one or more *e* cards had been at various other positions in its vicinity (see Figs. 2 and 5). The frequent "tests" probably tended to break down to some extent this training because in them bees going to an *f* card found that at that time *f* did not mark the site of the nest but that sometimes *e* did. Furthermore, these tests presumably included bees that recently emerged and, so, had not been subjected to full training. In spite of these unfavorable factors, a comparison of the observed scores with numbers expected on the basis of pure chance show that in all of the seventeen tests (see Table 1), except the first, *f* exceeded expectation. Combining all of the tests, *f* scored 506 and *e* scored 124, a ratio of 4.1 to 1, whereas chance would have given a ratio of only 0.8 to 1.

Whatever may be this insect's reactions at a greater distance, when alighting it is influenced most by the appearance of a band 4 to 8 mm. wide along the lower half of its entrance hole, this being the place on which it actually alights.

The fact that this feral species in its natural environment appreciates and reacts to reflected ultraviolet of sunlight adds to the importance of considering the ultraviolet color of many flowers when discussing the relation between floral color and the behavior of flower-visiting insects.

TABLE I.—Summary of tests in which all of the cards appeared to humans to be almost uniformly white but each of the cards had a distinctive pattern in ultraviolet (see Fig. 2). During training the *f* card had marked the location of the nest.

	Expectation on Basis of Chance										Observed Scores										Totals
	<i>e</i>	<i>f</i>	<i>h</i>	<i>i</i>	<i>j</i>	<i>k</i>	<i>l</i>	<i>m</i>	<i>n</i>	<i>o</i>	<i>e</i>	<i>f</i>	<i>h</i>	<i>i</i>	<i>j</i>	<i>k</i>	<i>l</i>	<i>m</i>	<i>n</i>	<i>o</i>	
March	13.3	6.7	.....	.....	.....	.....	.....	.....	.....	.....	15	5	..	..	..	..	..	..	..	..	20
12	5.3	2.7	.....	.....	.....	.....	.....	.....	.....	.....	2	6	..	..	..	..	..	..	..	..	8
13	2.6	1.3	.....	.....	.....	.....	.....	.....	.....	.....	1	3	..	..	..	..	..	..	..	..	4
	2.0	1.0	.....	.....	.....	.....	.....	.....	.....	.....	0	3	..	..	..	..	..	..	..	..	3
14	13.3	6.7	.....	.....	.....	.....	.....	.....	.....	.....	4	16	..	..	..	..	..	..	..	..	20
	14.7	7.3	.....	.....	.....	.....	.....	.....	.....	.....	9	13	..	..	..	..	..	..	..	..	22
15	12.0	6.0	.....	.....	.....	.....	.....	.....	.....	.....	4	14	..	..	..	..	..	..	..	..	18
	27.3	13.7	.....	.....	.....	.....	.....	.....	.....	.....	21	20	..	..	..	..	..	..	..	..	41
17	33.3	16.7	.....	.....	.....	.....	.....	.....	.....	.....	7	43	..	..	..	..	..	..	..	..	50
	33.3	16.7	.....	.....	.....	.....	.....	.....	.....	.....	10	40	..	..	..	..	..	..	..	..	50
19	50.4	57.6	.....	.....	.....	.....	.....	.....	.....	.....	16	92	..	..	..	..	..	..	..	..	108
20	22.0	29.3	.....	29.3	29.3	.....	.....	.....	.....	.....	3	50	..	49	8	..	..	..	..	..	110
21	30.0	30.0	.....	.....	.....	30.0	30.0	30.0	.....	.....	11	36	..	..	..	45	38	20	..	..	150
22	24.2	24.2	.....	.....	.....	24.2	24.2	24.2	.....	.....	3	48	..	..	..	6	39	25	..	..	121
23	13.8	13.8	13.8	.....	.....	.....	.....	.....	13.8	13.8	1	35	22	..	..	..	..	..	8	3	69
	19.0	19.0	19.0	.....	.....	.....	.....	.....	19.0	19.0	7	44	24	..	..	..	..	..	16	4	95
	18.6	18.6	18.6	.....	.....	.....	.....	.....	18.6	18.6	10	38	22	..	..	..	..	..	14	9	93
Totals	335.1	271.3	51.4	29.3	29.3	54.2	54.2	54.2	51.4	51.4	124	506	68	49	8	51	77	45	38	16	982

AMERICAN MUSEUM NOVITATES

Number 642

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

July 5, 1933

59.57, 72 B (728)

NOTES ON SOME BOMBYLIIDAE (DIPTERA) FROM PANAMA

BY REGINALD H. PAINTER¹

The small collection of Bombyliidae reported upon in this paper was submitted to the writer for identification by Mr. C. H. Curran. In the case of some of the commoner species, only a few representatives of each have been seen. Additional specimens identified by Mr. Curran have been added to the list. Among the specimens are two representatives of an interesting new genus and species. A second species belonging in this same genus but collected in South America is also included. The types, except as indicated, have been deposited in The American Museum of Natural History.

NEODISCHISTUS, new genus

This new genus possesses characters of the subfamily Bombyliinae as defined by Bezzi, and the following.

Head much broader than high, somewhat broader than the thorax; occiput flat, ocelli rather widely separated; face and front in female quadrate in shape, the inner margins of the eyes parallel; eyes bare, in the female with facets of equal size, slightly emarginate behind; face short and somewhat prominent; genae very narrow; proboscis about three times as long as the head; palpi single jointed, minute. Eyes of male contiguous, facets of two sizes, the smaller below. Antennae inserted about two-thirds of the way between ocelli and oral margin, their bases close together; first joint cylindrical, more than one and one-half times the length of the second; third cylindrical, about twice the length of the first two taken together, notched near the apex and bearing a minute style near the proximal margin of this notch, first and second joints clothed with stiff hairs, the third with minute pile.

Thorax broad and short, somewhat convex above, clothed with broad flat scales and stiff hairs; bristles present but not strong. Metapleurae bare. Scutellum rather large with bristles around the posterior margin. Squamae of moderate size with fringe of hairs; halteres large. Body somewhat gibbous.

Abdomen triangular, somewhat longer than broad, a little broader than thorax at base, clothed with broad, flat, appressed scales and a few stiff hairs along margin of abdomen. Female genitalia clothed with many hooked hairs. Legs long, clothed with scales and weak spines; pulvilli present, nearly as long as claws. Wings, in known species, hyaline; venation somewhat similar to *Sparnopolius*. R-m cross-vein at basal fourth of discal cell, making cells R and M of nearly equal length. Three interradials (two submarginal cells); R₅ open: cells M, second M₂ and Cu₁ present; anal cell widely open.

GENOTYPE.—*Neodischistus currani*, new species.

¹Contribution No. 410 from the Department of Entomology, Kansas State College, Manhattan, Kansas.

The chief characteristics of this genus are the venation; the cylindrical third joint of the antenna, which bears a style before the apex as in *Phthiria* and *Rhabdoselaphus*; and the vesture, which consists of broad shining scales. In Williston's¹ key to genera, this genus would trace to couplet 31 or to *Sparnopolius*; in Edward's² key, to *Acrophthalmomyda*. From *Sparnopolius* and *Dischiatus*, to which it is related, it differs in the type of body vesture and in the structure of the antennae. The same difference, as well as others that are evident from the description, holds for the other Nearctic or Neotropical Bombyliinae in which the vein M reaches the margin of the wing. From *Platymodes* it differs in the position of the r-m cross-vein; in the presence of only three interraddial cells; and in the shape of the antennae. From the other described genera of Bombyliinae it differs in the shape of the antennae; and from most of them in the flat scale-like vesture.

KEY TO SPECIES

- Orange pile behind occiput; front convex.....*collaris*, n. sp.
Black pile behind occiput; front concave.....*currani*, n. sp.

Neodischistus currani, new species

Figures 1, 5, and 11

FEMALE.—Entirely black, oral cavity yellowish. Antennae with first joint 0.2 mm.; second joint 0.1 mm.; third joint 0.6 mm. Front concave. Body and head clothed throughout with black hairs and appressed, iridescent, black scales, appearing greenish on the head and thorax, purplish on abdomen. Small patches of broad, silvery scales on each side of the face; on occiput, in the emargination of the eye; on mesopleura, sternopleura, hypopleura, posterior coxae, and the sides of the fourth, fifth, sixth, and seventh abdominal segments. Each patch consists of about a dozen scales or less. Some scales are transparent rather than silvery. Similar patches of scales on the under side of segments two, three, four, and five. A tuft of fine yellow, hooked hairs about the genitalia. Wings hyaline. Length, 6 mm.

MALE.—Body black; basal joints of antennae and posterior tibiae brownish; front silvery pollinose. Hairs chiefly black; those of upper part of occiput, dorsum of thorax and abdomen whitish in some lights. Scales mostly black, iridescent, but a few larger and silvery or transparent ones on mesopleurae, sternopleurae, and hypopleurae, located in all cases among sparse tufts of black hair. A few similar scales on each side of the front and on the apex of the abdomen where they form a connected ladder-like pattern. This pattern consists of a central and two lateral stripes from segment three to the apex of abdomen, connected by bands along the junction of segments five and six, six and seven, seven and eight. Patches of silvery scales are present on the under side of segments one, two, three, four, and five. Genitalia retracted and in a symmetrical position. Wings hyaline. Length, 4.5 mm.

¹Williston, S. W. 1908. 'North American Diptera.' New Haven, Conn.

²Edwards, F. W. 1930. 'Diptera of Patagonia and South Chile.' Part V, Fasc. 2. Published by British Museum.

Types.—Holotype, female, Corozal, Panama Canal Zone, Jan. 19, 1929. Allotype, male, Tintina, Santiago d. Estero, Argentina, Feb. 21, 1920, Cornell University Collection. Paratypes: female, Corozal, Panama Canal Zone, Jan. 19, 1929 (C. H. Curran); one female, Tintina, Santiago d. Estero, Argentina, Feb. 21, 1920, Cornell University Collection.

The female from Argentina is somewhat rubbed but in most respects like those from Panama. There are fewer white scales on the abdomen and the third joint of the antennae is proportionately shorter. In the male the third antennal joint is lacking.

This species is named in honor of the collector.

Mr. Curran says in connection with the capture of these specimens: "The specimens were found in a patch of long grass in the middle of a wide trail and represent two of the three specimens seen. One disappeared too quickly to permit capture and although I spent a considerable time in the region I could find no more. The spot was visited on several other days but proved barren."

Neodischistus collaris, new species

Figures 6 and 8

FEMALE.—Body black, face brownish gray; basal joints of antennae brownish; posterior tibiae and knob of halteres yellowish brown. Antennae: first joint 0.15 mm., second joint 0.075 mm., and third joint 0.55 mm.; third joint more spindle-shaped than in *curranii*. Front convex. All hairs and scales black except for a conspicuous orange fringe of pile between occiput and thorax on the dorsum. Scales of body have a brassy iridescence; spines black, on femora and tibiae yellowish. Wings hyaline. Length, 5 mm.

Types.—Holotype, female, Tucuman, Argentina, Jan. 22, 1928 (H. E. Box), in author's collection. Paratype, female, Aquidauana, Matto Grosso, Brazil, Dec. 11-13, 1919, Cornell University Collection.

Heterostylum stigmatias Knab

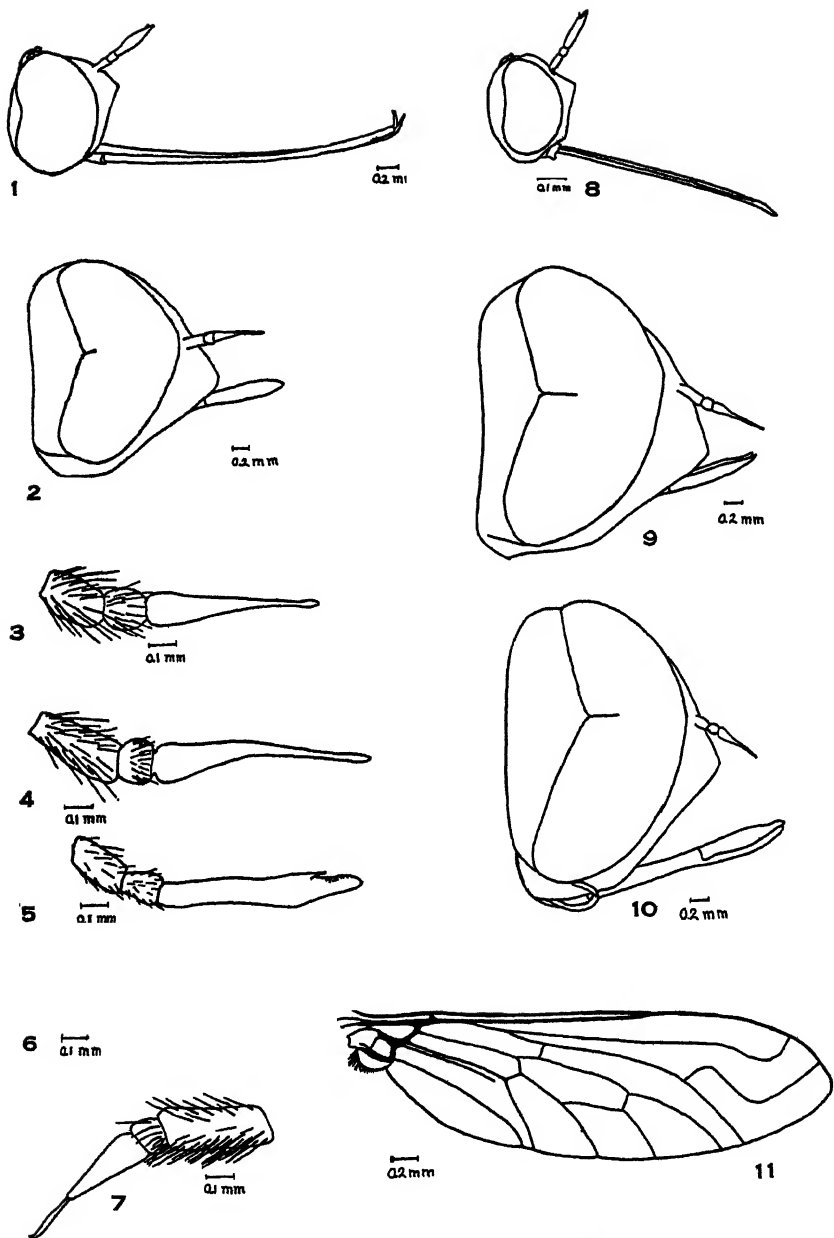
PAINTER, 1930, Journ. Kans. Ent. Soc., III, pp. 1-7.

One female, Corozal, Canal Zone, Jan. 21, 1929 (C. H. Curran).

Dr. J. M. Aldrich states in a recent letter that it is very doubtful if *H. rufum* (Olivier), with its synonym *Bombylius basilaris* Wiedemann is distinct from *stigmatias*. It probably will be necessary to await a study of the types or longer series in order to be certain regarding the number of species represented.

Toxophora aurifera Rondani (1848)

One male, two females, Ft. Randolph, Canal Zone, Jan. 23, 1929 (C. H. Curran). One female Balboa, Canal Zone, Nov. 7, 1923.



Figs. 1-11.—Panamanian Bombyliidae.

1, *Neodischistus currant*, n. sp.; 2, *Ezoprosopa spadix*, n. sp.; 3, *Villa rarus*, n. sp.; 4, *Villa argentosa*, n. sp.; 5, *Neodischistus currant*, n. sp.; 6, *Neodischistus collaris*, n. sp.; 7, *Ezoprosopa spadix*, n. sp.; 8, *Neodischistus collaris*, n. sp.; 9, *Villa argentosa*, n. sp.; 10, *Villa rarus*, n. sp.; 11, *Neodischistus currant*, n. sp.

This species is probably the same as *T. leucopyga* Wiedemann (1828) and if so should carry Wiedemann's name.

***Toxophora cuprea* (Fabricius)**

One female, near light house, Barro Colorado Island, Canal Zone, Dec. 3, 1930 (H. F. Schwarz); one male, same data (E. T. Huntington); one male, two males, Ft. Randolph, Canal Zone, Jan. 23, 1929, and Nov. 6, 1929 (C. H. Curran).

The size and number of the black spots on the last segments of the abdomen are variable: there may be either three or four present in specimens taken at the same time and place. These spots are very nearly absent in the female. The black scales may have either a greenish or purplish reflection.

***Anthrax* species**

Seven females, Barro Colorado Island, Canal Zone, Dec. 23, 30, 1928, and Jan. 3, 5, 1929 (C. H. Curran).

These specimens may be *acroleuca* Wiedemann. There is a faint tinge of milky white in the hyaline part of the wing. The outline of the black area is quite different from that pictured by Macquart as *gideon* and which Osten Sacken says is like the type of *acroleuca*, which species has never been adequately described.

One female, taken at Saloanas, Panama, Nov. 14, 1923, F4860, may possibly be *luctuosa* Macquart. It differs from the specimens mentioned above in the distribution of the black area of the wing and various minor venational structures, the possession of white pile at the base of the abdomen, and the shape of the antennae. In view of the fact that specimens sometimes grouped under *A. anale* Say possess genitalic differences that accompany such color differences, it is probable that these two represent separate species. There are at least eight names that may be applied to Nearctic and Neotropical *Anthrax* with "half black wings." All of these have been inadequately described from one or two specimens usually from one sex. It would merely add to the confusion to describe new species or redescribe old ones in this group without a complete study of all.

***Anthrax trimaculata* Macquart**

One male, Corozal, Canal Zone, Jan. 31, 1929 (C. H. Curran).

A. initans Schiner and *Spogostylum inappendiculatum* Bigot are probably synonyms.

***Velocia latreillei* (Wiedemann)**

One male, two females, Barro Colorado Island, Canal Zone, Dec. 22, 30, 1928, Jan. 4, 1929 (C. H. Curran).

Mr. Curran reports a male and a female, Barro Colorado Island, Jan. 9, 1929; a female, Barro Colorado Island, Dec. 29, 1928.

***Velocia hela* (Erickson)**

Eighteen specimens, both sexes, Fort Randolph, Canal Zone, Jan. 23, 1929, and Feb. 6, 1929.

This species have previously been called *Hyperalonia albiventris* (Macquart), which name is a homonym.

***Exoprosopa limbipennis* Macquart**

One male, Corozal, Canal Zone, Jan. 31, 1929 (C. H. Curran); one female, Corozal, Canal Zone, Nov. 4, 1929 (C. H. Curran).

Mr. Curran reports additional specimens as follows: four specimens, both sexes, Barro Colorado Island, Dec. 22, 1928, and Jan. (H. F. Schwarz); three specimens, both sexes, Patilla Pt., Jan. 15, 1929; one female, Fort Randolph, Jan. 23, 1929; eleven specimens, both sexes, Corozal, Jan. 16, 19, 21, and Feb. 4, 1929.

***Exoprosopa spadix*, new species**

Figures 2, 7, and 12a

Orange tomentose, middle of abdomen black tomentose; pale yellow tomentose bands on second, fourth, sixth, and seventh segments. Wings bifasciate; cell R_1 closed and petiolate. Length, 9.2 mm.

MALE.—Ground color brownish, center of abdomen black. Head black pilose and orange tomentose; proboscis surpassing oral cavity by the length of the labella. Antennae with first joint light brown; first and second joints black pilose; second and third joints dark brown. Length of antennae: first joint, 0.3 mm.; second joint, 0.1 mm.; third joint without style, 0.3 mm.; style, 0.25 mm.

Thorax orange tomentose and pilose; some black pile on dorsum, mesopleurae and coxae. Tomentum of scutellum, except at the margin, black.

Ground color of abdomen yellowish on sides and venter, black in the center above. Pile black; on first segment and anterior parts of second, orange-yellow. Tomentum black in the center but on the sides becoming mixed with orange; yellow tomentose cross-bands on the base of segments two and four, and over nearly all of segments six and seven. On segment four the band is narrow and interrupted in the center. Venter orange pilose and tomentose, some scattered black scales and hairs on segments five, six, and seven. Legs black and orange tomentose, and with black spines. Wings brown with lighter areas below the fork of R_s and in front of the r-m cross-vein; tip of the wing and a band extending from the discal cell to the margin, yellowish hyaline.

TYPE.—Holotype, male, Bruja Point, Canal Zone, Jan. 25, 1929 (Curran).

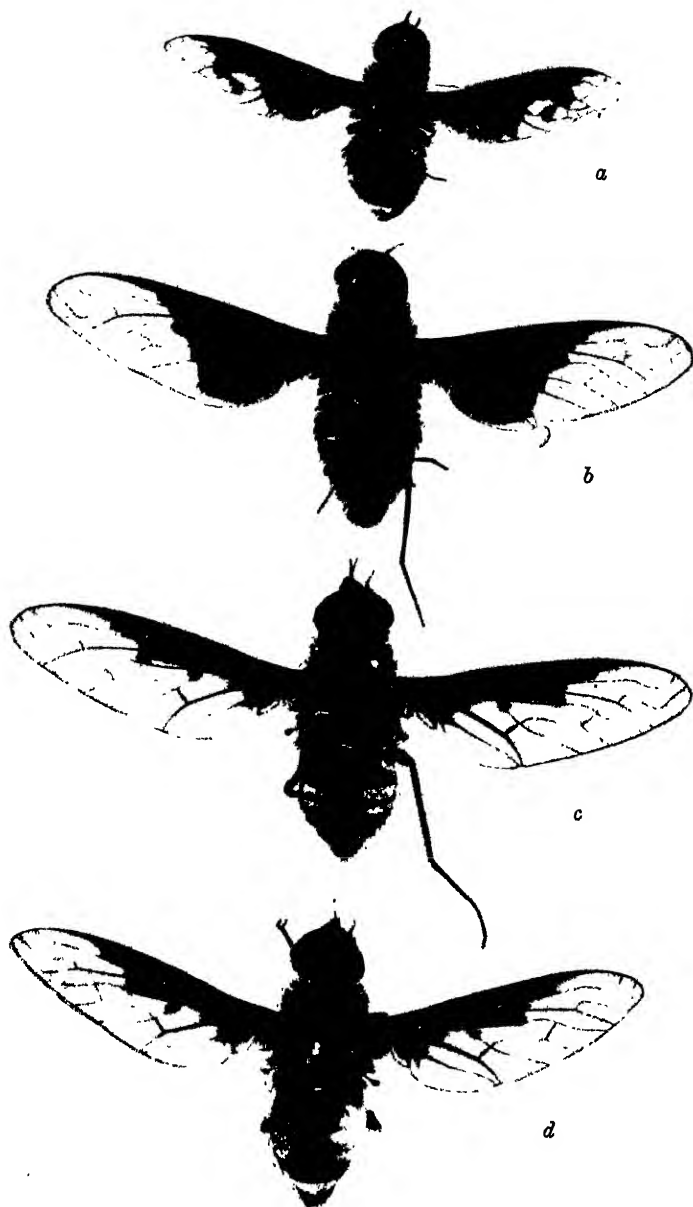


Fig. 12—Panamanian Bombyliidae.
a, *Exoprosopa spadix*, n. sp., type; *b*, *Villa rarus*, n. sp.; *c*, *Villa argentosa*, n. sp., female; *d*,
Villa argentosa, n. sp., male.

***Stonyx clotho* (Wiedemann)**

One female, Patilla Point, Canal Zone, Jan. 15, 1929 (C. H. Curran); two males, one female, Corozal, Canal Zone, Jan. 19, 21, 22, 1929 (C. H. Curran.)

In addition, Mr. Curran reports: fifteen specimens, both sexes, Barro Colorado Island, Dec. 27, 1928, Jan. 7, 8, 10, 11, 1929; twenty-nine specimens, both sexes, Corozal, Jan. 16, 19, 21, and Feb. 4, 1929; three males, Fort Randolph, Jan. 23, 1929.

***Villa edititia* (Say)**

One male, one female, Patilla Point, Canal Zone, Jan. 15, 1929 (C. H. Curran); one female, Fort Randolph, Canal Zone, Jan. 23, 1929.

In addition Mr. Curran reports: five specimens, both sexes, Patilla Point, Jan. 15 and Feb. 1, 1929; one male, Bruja Pt., Jan. 25, 1929; four specimens, both sexes, Corozal, Jan. 19 and Feb. 4, 1929; ten specimens, both sexes, Fort Randolph, Jan. 23, 1929.

***Villa (Chrysanthrax) argentosa*, new species**

Figures 4, 9, and 12c, d

Body mostly brownish or black; face conically produced; third joint of antennae conical, tapering from base to apex; abdomen silvery and black tomentose. In both sexes, the center of the abdomen and the fifth abdominal segment are black tomentose; in the male the remainder is silvery; in the female, segments six and seven and a spot on each side of segments two, three, and four are silvery. Venter largely blackish tomentose and pilose. Wings smoky hyaline, front margin brown. Front tibiae without spines. Length, 8-14 mm.

MALE.—Head, ground color dull black, face with oral margins yellowish, a streak of this color passing up to the base of each antenna and meeting in a V-shaped mark on the front; front and face black pilose, black and yellowish tomentose; occiput yellowish-white tomentose; proboscis exceeding the oral cavity the length of the labella. First and second joint of antennae yellowish; black pilose; third joint brownish black.

Thorax blackish brown in ground color; apical two-thirds of scutellum red; dorsum of thorax and scutellum black tomentose; margins of thorax yellow pilose and tomentose, a strip of yellow tomentum across the posterior part of the thorax and around the posterior margin of the scutellum; bristles yellow and black; pleurae and legs black tomentose and pilose. Ground color of legs dark brown; front coxae and base of front femora black; anterior tibiae without spines. Wings smoky hyaline; anterior part brownish, a black spot near base of discal cell and about the r-m cross-vein.

Abdomen black tomentose and pilose; sides of first segment, venter, and inner part of genitalia yellow pilose; sixth and seventh segments and a spot on the sides of the second, third, and fourth segments silvery tomentose, the ground color beneath these silvery portions largely or wholly yellow.

FEMALE.—Similar to male except that the silvery spots on each side of abdomen are interrupted at the apices of each segment.

TYPES.—Male, Corozal, Canal Zone, Jan. 19, 1929; allotype, female, Corozal, Canal Zone, Jan. 31, 1929 (C. H. Curran). Paratypes: nine males, two females, Corozal, Canal Zone, Jan. 10, 16, 19, 21, 22, 31, 1929, and Feb. 4, 1929 (C. H. Curran).

***Villa (Chrysanthrax) ravus*, new species**

Figures 3, 10 and 12b

Body mostly brownish black; face conically produced, third joint of antennae conical, tapering from the base to apex; thoracic margins bright yellowish pilose and tomentose; abdomen black tomentose and pilose, some poorly defined yellowish tomentose spots on the sides of each segment; venter largely black pilose and tomentose; wings brownish on basal half; front tibiae without spines. Length, 13 mm.

FEMALE.—Head ground color dull black; face with a yellow stripe below each antennae extending up to form a triangular yellow spot on the center of the front above the base of the antennae; face and front black pilose and yellow tomentose, a strip of black tomentum between the antennae; occiput yellow tomentose; tips of labella surpassing oral cavity, first and second joint of antennae yellow, black pilose, third brownish black.

Thorax blackish brown; apical four-fifths of scutellum red, black, and yellowish pilose, the latter present sparsely on the metanotum, and prothorax; in front of, and behind the wing roots, and on the front coxae; bristles yellow and black; remainder of pleurae and legs black pilose and tomentose, brownish black in ground color; anterior tibiae without spines; wings with apex hyaline, base brownish.

Abdomen black in ground color, a reddish spot in the center at each side of segments two, three, and four; black tomentose and pilose, first segment yellow pilose; ill defined small, yellow tomentose spots on the sides of each segment; venter yellowish and black pilose; genitalia yellow pilose.

TYPES.—Holotype, female, and paratype, female, Patilla Point, Canal Zone, Jan. 15, 1929 (C. H. Curran).

The paratype has an extra cross-vein in cell R_5 in a position similar to that in *Exoprosopa divisa* (Coquillett). This species is closely related to *argentina*.

***Villa lateralis* (Say)**

One female, Patilla Point, Canal Zone, Jan. 15, 1929 (C. H. Curran).

***Villa lateralis fulvipes* (Coquillett)**

One female, Patilla Point, Canal Zone, Jan. 15, 1929 (C. H. Curran).

***Villa orbitalis* (Williston)**

One male, Corozal, Canal Zone, Jan. 22, 1929. Five females, Corozal, Canal Zone, Jan. 15, 16, Feb. 3, 1929 (C. H. Curran); Corozal, Canal Zone, Nov. 17, 1930 (H. F. Schwartz); Barro Colorado Island, Canal Zone, Nov. 22, 1930.

This species, *sagata* Loew, *curta* Loew, *celer* Wiedemann, and *floridana* Macquaert are all closely related. There are at least six South American species that belong to the same group. It will be necessary to make a comparative study of a large number of specimens to determine the exact relationships. The specimens mentioned above were compared with cotypes from the American Museum and are the same species.

***Villa paradoxa* (Jaennicke)**

Patilla Point, Feb. 1929.

Two males of *Diplocampta singularis* Schiner have been examined and they are not congeneric with this species as stated by Curran.¹

¹Curran, C. H. 1931. 'First supplement to the Diptera of Porto Rico and the Virgin Islands.' Amer. Mus. Novitates, No. 456, p. 7.

AMERICAN MUSEUM NOVITATES

Number 643

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

July 5, 1933

59.57, 72 S (728.1)

TWO NEW DIPTERA FROM GUATEMALA

By C. H. CURRAN

The two new forms described in this paper were included in a small lot of flies forwarded for determination by Dr. Joseph Bequaert. The types are in The American Museum of Natural History.

STRATIOMYIDAE

Merosargus pictithorax, new species

In my key to the species of *Merosargus*,¹ this traces to couplet 13, where it fits neither alternative, although coming close to *hyalopterus* Giglio-Tos. *M. pictithorax* differs from *hyalopterus* in having a broad, interrupted, shining black median vitta on the mesonotum, and interrupted sublateral vittae. Length, 9.5 mm.

FEMALE.—Head sulphur yellow; lateral frontal depressions and narrow frontal orbits above, a band extending across the ocelli, and the occiput except in the middle above the neck, shining black. Hair reddish yellow, black on the transverse ocellar band. Antennae reddish, the third segment suboval. Proboscis reddish yellow.

Thorax sulphur yellow; pectus with rusty reddish tinge; mesopleura with a large, triangular, shining black spot in the middle; mesonotum with shining black markings as follows: a median vitta, broad in front of the suture, triangular behind the suture, being pointed in front and expanding to form a prescutellar band; a broad, incomplete, interrupted vitta toward either side, the posterior spot furcate posteriorly; about the basal third of the scutellum shining black. Hair yellow, black on the black mesonotal markings. Metanotum metallic green.

Legs reddish yellow, the apical three tarsal segments black; hair yellowish, black on the posterior four femora and coxae and on the apical tarsal segments.

Wings with luteous tinge. Squamae with brownish border and reddish-brown fringe. Halteres yellow.

Abdomen rusty yellowish-red, the second to fifth segments each with a broad shining black basal fascia, the fascia on the second segment widest laterally and narrowly interrupted in the middle, the others widest in the middle and entire; first segment with a narrow, incomplete, narrowly interrupted subapical fascia. Hair black on the first segment and on the black bands, yellow on the yellow fasciae. Venter rusty reddish, the fourth and fifth sternites with more or less developed black or brown basal fasciae, the hair yellowish, mostly black on the fifth sternite.

HOLOTYPE.—Female, Moc Gustalon, Guatemala, 1000 m., March-April, 1931 (J. Bequaert).

¹American Museum Novitates, No. 534, p. 1.

SYRPHIDAE

Salpingogaster bequaerti, new species

In my key to the species belonging to this genus¹ traces to *nigra* Schiner but is at once distinguished by its small size, presence of a yellow stripe on the metapleura, very differently shaped fourth sternite in the male, etc. Differs from *limbipennis* Williston in having the tibiae yellow on the basal third or more and in lacking the brown cloud over the cross-veins. Length, 8 to 9 mm.

MALE.—Sides of the face and front palc yellow, the frontal triangle and very broad median facial stripe blackish, the facial stripe narrowed below the tubercle; cheeks black, the back of the mouth yellow; occiput black, cinereous pollinose and with whitish hairs. Face with very short, fine yellowish pile, the front with some fine, short blackish hairs below and some shorter ones above. Facial tubercle strong, the antennal tubercle moderately prominent, not produced as in *nigra*. Antennae pale brownish, the third segment obtusely oval.

Thorax black; humeri, notopleura, posterior calli, a stripe extending over the mesopleura and sternopleura and a stripe on the metapleura, pale yellow; mesonotum without distinct pollinose vittae; pile very short, pale in color. Scutellum brown, bare, the base yellow, the apical border reddish.

Legs blackish or brown, the tips of the femora, basal third of the anterior and posterior tibiae and the basal half of the middle pair, pale yellow; basal two or three tarsal segments dull reddish.

Wings hyaline, the costal border broadly deep brown, the brown broadened apically where it extends to the third vein from a point a little beyond the "loop" of the vein, also extending back to the third vein before the anterior cross-vein. Squamae rather brownish yellow, bare. Knob of halteres brown.

Abdomen brown; first segment and narrow base of the second pale yellow; third segment with a broad, sub-basal band which widens laterally, the apex of the segment narrowly pale yellow. Hair very short and brownish, but appearing pale in some views. Apex of fourth sternite emarginate, not strongly produced on the sides; the usual mammiform process on the genitalia long.

FEMALE.—Front narrow above, black, the sides narrowly pale yellow almost to the level of the anterior ocellus. Abdomen more strongly broadened, the apex of the fourth segment pale yellow. Ovipositor large, rather cylindrical, somewhat longer than wide.

Types.—Holotype, male, Sa Emilia, Pochuta, Guatemala, 1000 m., February-March, 1931 (J. Bequaert); allotype, female, Patulul, Guatemala, July 12, 1931 (Marston Bates). Paratype, female, Sa Emilia Pachuta, 1000 m., March-April, 1931 (Bequaert).

¹American Museum Novitates, No. 519, p. 5.

AMERICAN MUSEUM NOVITATES

Number 644

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
NEW YORK CITY

July 5, 1933

55.1, 78 (82.9)

STRATIGRAPHIC NOMENCLATURE OF THE EARLY TERTIARY OF CENTRAL PATAGONIA¹

BY GEORGE GAYLORD SIMPSON

In the prosecution of research on the collections of the Searritt Patagonian Expedition, it was at first intended to postpone discussion of stratigraphic nomenclature until the preparation and identification of specimens were complete and their full stratigraphic significance determined. In preliminary publications, in cataloging, and in manuscript for the definitive memoir, horizons have been indicated according to the biological names of Ameghino, *Notostylops* Beds, *Astraponotus* Beds, etc. As the work has progressed, however, this has become increasingly inconvenient and it has become apparent that the selection of some uniform nomenclatural system, definitive as far as it can be on present knowledge, is very desirable in order to obtain permanence of record and to avoid needless labor. This nomenclature is, furthermore, in an extremely confused condition, and a conservative attempt to sum up the synonymy of the literature and to give a basis for greater future uniformity must be useful.

The scope of this inquiry is the naming of the subdivisions of the terrestrial deposits of Tertiary age which underlie the great marine Patagonian formation in southern Chubut and northern Santa Cruz. Some older beds will be mentioned only so far as they bear on this problem.

In the first place it is clear that the series of strata so defined is complex and that its subdivisions, so far as now indubitably recognizable, should have distinctive and clearly defined names. As criteria for the selection or proposal of such names, the following seem to be in general accord with the soundest international usage:

1. New names should be proposed only when absolutely required.
2. Names should be applied to each stratigraphic entity which is definitely known on data faunal, lithologic, or structural to be a distinctive unit.
3. As opposed to names of epochs, étages, life-zones, and the like, names given to definite local formations and to their members should extend only to beds in complete or essential lateral continuity or to dis-

¹Publications of the Searritt Patagonian Expedition, No. 18.

continuous beds which can be shown beyond any reasonable doubt to be both contemporaneous in time and similar in origin.

4. Again as opposed to some larger rock categories or some time categories, names of these definite local stratigraphic units should invariably be geographic and preferably taken from a name applied to a geographic feature at or near a good and typical development of the formation or member so named.

Ameghino 1906		Gaudry 1906	Windhausen 1924		Feruglio 1929	
[Lower part of] Patagonienne	Colpodonéen	du Deseado	Tobas mamíferas del Eogeno	Colpodonense	Capas con Colpodon	
Guaranienne	Pyrotheréen			Pyrotheriense	Capas con Pyrotherium	
	Astraponotéen			[Not dis- tinguished]	Notostyloperse	Capas con Astraponotus
	Notostylopéen			de Casamayor		Capas con Notostylops
	Notostylopéen Basal	[Not dis- tinguished]	Estratos con Dinosaurios Sección Superior		Pehuenche	
	Salamanquéen	Magellanian	Salamanqueano		Salamanqueano	
	Pehuenchéen	[Upper part of] Guaranien	[Upper part of] Estratos con Dinosaurios Sección Inferior		[Upper part of] Chubutiano	

Fig. 1. Synonymy of names applied to the late Cretaceous and Eocene of Central Patagonia.

5. Non-geographic names for such units, and specifically those based on lithology or on the names of supposedly characteristic fossils, should be rejected.

6. Homonyms, that is, names essentially identical with others already used (in the same country or region) with a different meaning, should be rejected.

7. If a name previously proposed is to be given a more restricted meaning, it should be applied to a unit included under that name by its original author.

8. While priority is not invariably to be followed, the names adopted should in general be the oldest applicable without ambiguity.

9. Names should in general be retained with their original meaning as nearly as possible without ambiguity, but this should not be taken as

Kraglievich 1930		Frnguelli 1930			Simpson 1933
[Lower part of Santacruceana]	Trelewense	[Lower part of] Patagonico	[Lower part of Santacruziano]	Colihuehua- piense	Colhué-Huapi
Deseadoana	Deseadense		Deseadiano	Deseadense	Deseado
	Mustersense			[No name given]	Musters
Casamayorana	Casamayo- rense			Casamayorense	Casamayor
	Colihuehua- piense				
[Not discussed]		[Upper part of] Chubutico	[Part of] Pehuenchiano	Sehuenense	Río Chico ----- ? -----
				Salamanquense	Salamanca
				Pehuenchense	[Upper part of] Chubut

Fig. 2. Synonymy of names applied to the late Cretaceous and Eocene of Central Patagonia.

an excuse for renaming a formation every time some slight modification of its limits is necessary.

These criteria are rather generally recognized, and in part quite obvious, but they have not been consistently applied to the sequence here discussed.

The various nomenclatural systems proposed for the Eocene of

central Patagonia are typified by Ameghino's final arrangement (1906), Gaudry's interpretation of Tournouër's data (Gaudry 1906), Windhausen's report of 1924, Feruglio's classification of 1929, Kraglievich's general scheme for all the Argentine mammalian faunas (1930), and Frenguelli's Patagonian nomenclature (1930). These are compared in the accompanying table, which does not represent the authors' ideas as to correlation, age, etc., but only the probable or clear synonymy of the names used by them for particular formations in this one region. In this selection I do not ignore nor mean to slight the valuable stratigraphic work of Groeber, Keidel, Loomis, Ramaccioni, Roth, Stappenbeck, Tapia, Wickmann, Wilckens, and many others. The limits of the present paper do not permit exhaustive discussion of the geologic problems involved, and it is confined to the selection of an adequate nomenclature with only such detail regarding stratigraphic questions as is absolutely necessary for this purpose.

The first step is to decide what subdivisions of the series may properly be named (or have older names recognized) at the present time. The two limiting marine horizons already have almost universally accepted and entirely correct names: Patagonia, Patagonian, Patagoniano, etc., for the mid-Tertiary overlying group, and Salamanca, Salamancan, Salamanqueano, etc., for the probably Senonian underlying group which contains purely marine beds but includes also coastal, estuarine, or even perhaps partly fresh-water strata. Directly beneath the Patagonian are the *Colpodon* Beds of Ameghino, a well defined unit certainly requiring a distinctive geographic name.¹ The next lower formation, *Pyrotherium* Beds of Ameghino, Deseado of Loomis and others, is likewise distinctive and already generally accepted as a nameable unit.

The next older fauna and corresponding stratigraphic subdivision named by Ameghino, his *Astraponotus* Beds, have been less generally recognized. Several authors (e.g., Gaudry, Frenguelli) simply ignore this zone. Others (e.g., Kraglievich) accept Ameghino's data without any restudy or critical evaluation. No one except the Ameghinos has published any original research consciously² involving this formation. The fauna and formation do exist. There is a very marked break between the *Notostylops* and *Pyrotherium* faunas of Ameghino, a break represented in the field either by a distinct erosional unconformity or by intervening strata which do in fact contain a recognizably distinctive and intermediate fauna. These strata are not yet well understood. The

¹There is evidence, strong but not absolutely conclusive, that the so-called *Colpodon* Beds (Collhué-Huapi Formation) are contemporaneous with the lowest Patagonian. In any event, they constitute a distinctive formation, being of purely terrestrial origin, different in aspect and fauna from the possibly synchronous marine beds.

²Many of Roth's fossils apparently belong to this fauna, but he did not accept them as such.

boundaries have still to be exactly established. It is possible that Ameghino did not in every case correctly determine the exact faunal position of specimens from near the lower boundary. It is further possible that this fauna is itself to be subdivided into lesser faunules or facies. These problems for future research (some of them at least partly soluble from data now in my hands) do not alter the fact that Ameghino's *Astraponotus* Beds do exist, are distinctive, and require a name.

Finally, at the base of the sequence are Ameghino's *Notostylops* Beds. Ameghino believed these to include several different faunas and formations, saying, for instance (1906, p. 465), "En réalité ce n'est pas une faune sinon la succession de trois faunes, peut-être de quatre . . .," but (Ibid., p. 466), "pour le moment je crois convenable de les énumérer comme constituant dans leur ensemble une seule grande faune. . . ." He had previously (1902, p. 4) given lists of genera distinctive of a "Notostylopense superior" and of a "Notostylopense inferior," but his action of 1906 in uniting these into a single list tacitly recognizes the fact that this division, if not incorrect, was premature. It is probable that this formation can be zoned, but this has not yet been done, and the zoning suggested by Ameghino (previous to 1906) is not in fact recognizable and was more hypothetical than real. For the present, these beds must be considered and named as a unit.

Ameghino further mentioned the existence of a still lower unit, the "Notostylopense basal" (or Notostylopéen basal). His references to this are not wholly clear, but he seems in a general way to have included under this name those beds between the Salamanca and the mammal-bearing "Notostylopense" (=Casamayor), that is, the strata called Pehuenche by Feruglio and other more recent students, including the "argiles fissilaires" of Mazaredo and the similar beds south of Colhué-Huapi. The name "Notostylopense basal" was rather theoretical, for Ameghino gives no evidence that *Notostylops* itself occurs here, and in fact, so far as I recall, he did not positively state that any mammals were found in these beds. Nevertheless I believe that Ameghino's understanding of the nature of this sequence was much better than that of any later student to the present time, and extraordinary and largely unnecessary confusion has resulted from rejecting his views, or from the failure to understand them.¹

¹Too detailed an account of the many stratigraphic interpretations would be merely confusing in this summary paper, concerned primarily with nomenclature. One important point regarding this part of the section is that Ameghino believed that his lower and, or, basal *Notostylops* Beds were synchronous with the Salamanca. This is surely erroneous, but—and from failure to make such a distinction have arisen most of the misunderstanding and unjust criticism of Ameghino—it is not an error of observation. He well knew and made very clear that his whole "Notostylopense" invariably overlies the Salamanca when both are present at one locality. The error was in his interpretation of them as replacing each other laterally.

Without reviewing subsequent work in specific detail, as it became generally accepted that the "Notostylopense" and all overlying beds were of Tertiary age, this underlying formation was invariably placed in the Cretaceous and it was even maintained that there is a marked angular unconformity above it. For a characteristic expression of this school of thought, see Windhausen, 1924. Feruglio, 1929, questioned some of the detailed evidence for this division, but continued to accept it in general as valid. The detailed field observations will be published elsewhere, but, as already mentioned (Simpson, 1932), our work shows beyond serious doubt that the supposed angular unconformity here is illusory, that if (as is quite probable) an unconformity does exist, it was not marked by much if any local folding in this region and does not represent a long lapse of time, and that at least a large part of this series of strata belongs indubitably in the Tertiary. This series contains a mammalian fauna, unaccompanied by dinosaurs, related to but not identical with that of the overlying Casamayor, and surely of Tertiary age. It is, or includes, a Tertiary formation, distinctive lithologically and faunally, which also requires a name.

The units for which names are to be selected or proposed here are, then, five: the *Colpodon*, *Pyrotherium*, *Astraponotus*, *Notostylops*, and "basal *Notostylops*" Beds of Ameghino.

Another unit very distinctive lithologically is the so-called "argiles fissilaires" of Ameghino. These beds (actually silicified tuffs and bentonites) are typically developed below the "*Notostylops*" and "*Pyrotherium* Beds" (Casamayor and Deseado) at Cañadón Lobo (Cañadón Tournouër) and Punta Nava, and also occur in the valley of the Río Deseado, at various places in the whole region south of Lago Colhué-Huapí, and in several other localities in central Patagonia, similar in lithology and stratigraphic position. Some rather different strata have been tentatively considered as belonging in the same category (e.g., near Malaspina, by Fergulio, 1929). Ameghino did not consider these as forming a distinctive horizon, saying (1906, p. 103), "Ces argiles fissilaires ne constituent pas un horizon déterminé, car il y en a dans le pyrothéréen, dans le notostylopéen, dans le salamanquéen, dans le péhuenchéen, et aussi dans les grès bigarrés." Yet most subsequent work has confined the designation to their typical development, particularly as seen at Cañadón Lobo and south of Colhué-Huapí. These were both included, at least in large part, in the "Notostylopéen basal" by Ameghino, and by most subsequent writers have been placed in the Cretaceous, with the "estratos superiores con dinosaurios," "Pehuenche,"

etc.; indeed the mooted angular unconformity was supposed to be just above them. Only recently (Piatnitzky, 1931) has it been suggested that the "argiles fissilaires" may belong in the Tertiary tuff series. This anticipates publication of our own independent conclusion that the "argiles fissilaires" are surely of Tertiary age and probably are nothing more than local, partly metamorphosed tuffs of the thick ash and bentonite series, probably usually of Casamayor age. In any event, they do not at present require a distinctive name. No identifiable fossils have ever been found in them.

Many writers have proposed names or used locutions which include the first four of the five formations here discussed or two or three of them. Windhausen (1924) called them all the "tobas mamíferas del Eogeno,"¹ and others have similarly called them "tobas mamalíferas," and so on. These designations are perhaps useful descriptively, but they are not actual names of a geologic group or formation, and their vagueness makes them decidedly out of place in any detailed stratigraphic work. As yet the relationship between these formations and their various faunas is not clearly enough established for a grouping of all together or of any two or more to be other than a tentative measure, a practical expedient. For more detailed and accurate work, particularly from a paleontological point of view, this expedient is unnecessary and may be a real impediment to progress in our understanding of this quite complex and long sequence of formations. Such understanding has hardly progressed beyond the recognition of five smaller units, analysis of which must precede any definitive synthesis. These five smaller units, themselves of very considerable size, are now recognizable and nameable.²

¹Cabrera (1927) has justly criticized the etymology of this phrase, pointing out that "tobas mamíferas" signifies "tobas que contienen o poseen mamas"—tuffs containing or having mammae—which is not what was really meant. He also criticizes the Spanish names formerly in very common use, "Notostylopense," "Astraponotense," etc. The termination -ense, Latin -ensis, is properly used only as an adjectival suffix after words of location. Casamayorensis is an etymologically correct Spanish name, but Notostylopense is not. The same error is occasionally made in forming neo-Latin specific names.

²Not as a criticism directed particularly at his valuable work, but because it typifies the attitude of those who consider all these beds as an indivisible unit, Frenguelli's opinion (1930, p. 56) may be quoted that "En los lugares fosilíferos, los restos de las faunas de *Notostylops*, *Astrapotherium* [*Astraponotus*? G.G.S.], y *Pyrotherium* se encuentran siempre desprendidos de su yacimiento y acumulados promiscuamente al pie de las barrancas. . . . No creo que los demás coleccionadores hayan podido hallarlos en condiciones diferentes, o por lo menos tales de poder ser utilizados como base seria de una clasificación estratigráfica." This almost casual brushing aside of the results of decades of careful, intelligent work seems to be a retrograde step in the study of the stratigraphy of this region. All work, from Ameghino's to our own, inevitably involves some error. Only by discerning, accepting, and augmenting the truth while correcting or rejecting the errors can progress be made. To reject a correct observation, because it was linked with an erroneous interpretation or for any other reason, is worse than accepting an error.

In this specific instance, we did find fossils in conditions "tales de poder ser utilizados como base seria de una clasificación estratigráfica," and so did Carlos Ameghino. In every section examined in detail we found identifiable guide fossils *in situ*. Of course specimens were also often found on the surface below their original horizons of burial, as is true in all paleontological collecting, and this necessitates some acumen and much care on the part of the collector. Some individual specimens or species were probably placed in the wrong zone by Ameghino and others, but our experience suggests that this was not frequent, and in any event the stratigraphic conclusions based on large collections are not vitiated by such errors in details.

Turning, then, to the names to be employed for the five terrestrial, lower Tertiary, mammal-bearing formations now recognizable, these may be taken up one by one, starting with the most recent, the so-called *Colpodon* Beds.

On June 9, 1899, Carlos Ameghino wrote to his brother suggesting the name "Colhuehuapense" for the highest mammal-bearing beds south of Lago Colhué-Huapi. The letter was published by Florentino Ameghino in 1900 (Ameghino 1903, p. 38—a separate edition of the same paper, previously published serially), but he did not adopt the name, calling this formation the "Colpodonense," "Colpodonéen," "Couches à *Colpodon*," etc. Almost all later authors have followed F. Ameghino. In 1908 (p. 102) Roth called the *Pyrotherium* Beds of Ameghino the "Colhuapi-Stufe." This was, essentially, giving the same name as Carlos Ameghino's to a wholly different formation.¹ So far as I know, no one has adopted Roth's name. In 1930 (p. 157) Kraglievich apparently overlooked the two previous uses of the name² and used it again with a third quite different meaning, calling the "Notostylopense inferior" of Ameghino the "Colhuehuapiense." At the same time Kraglievich proposed the new name "Trelewense" for the "Colpodonense" of F. Ameghino, a name unobjectionable in itself, but long antedated by the "Colhuehuapense" of Carlos Ameghino. Independently of Kraglievich and in the same year, Frenguelli (1930, p. 74) proposed to return to the name of C. Ameghino and to use "Colhuehuapiense" for the *Colpodon* Beds of F. Ameghino and others. This usage seems to me to be acceptable. The "Colhuapi-Stufe" of Roth and "Colhuehuapiense" of Kraglievich *non* Ameghino are to be rejected as homonyms. "Trelewense" of Kraglievich is rejected as a synonym of "Colhuehuapiense" of Ameghino *non* Kraglievich. The "*Colpodon* Beds" may be called the Colhué-Huapi Formation, Colhuehuapien in adjectival form, Colhuehuapiense in Spanish.

The next older faunal and stratigraphic unit was designated by Ameghino with names derived from the genus *Pyrotherium*. Gaudry 1906, p. 103) applied the name "*Étage du Deseado*" to the *Colpodon* and *Pyrotherium* Beds of Ameghino. Gaudry mentioned but did not accept the opinion that two distinct faunas occur. Nor, following

¹Roth's "Colhuapi" must be recognized as the same geographic name as Ameghino's "Colhué-Huapi," although he spelled and used it differently. In my papers I use the spelling Colhué-Huapi, because it is that now common in the literature and officially sanctioned. I do not believe it to be etymologically correct. It is not a good approximation of the Indian (Araucanian, not Tehuelche) name (pronounced nearly as Colu-ouapi would be in French) nor of the present pronunciation of the Spanish-speaking colonists near the lake (variable but generally about like the Spanish pronunciation of Coli-Huapi or Coluapi).

²A very excusable oversight, as both were published rather casually and were not subsequently used.

Tournouër, did he recognize that both, and not merely the younger, are present at the "Gisement du Coli-Huapi." Loomis (1914) apparently did not recognize that the "Deseado" of Gaudry included both *Colpodon* and *Pyrotherium* Beds of Ameghino, for he stated that "Tournier" (i.e., Tournouër) and Gaudry had named the *Pyrotherium* Beds as the Deseado Formation. Although apparently unconscious, this redefinition by Loomis is valid and convenient and has been generally accepted. This formation may continue to be called Deseado, Deseadoan, or Deseadense.¹

The *Astraponotus* Beds of Ameghino are happy in having little history. They have frequently been ignored altogether and when recognized this has been only by acceptance of Ameghino's views. So far as I know, the only geographic name ever applied to them is Mustersense of Kraglievich, 1930. This name may be accepted and this formation be called Musters (from the lake of that name), Mustersian, or Mustersense.

Of the three subdivisions of the "Notostylopense" suggested by Ameghino, Upper, Lower, and Basal, I believe that the first two should be included under one name, and the last given a different name. The formation which includes the upper and lower *Notostylops* Beds of Ameghino was named "Étage de Casamayor" by Gaudry, from Punta Casamayor. The designation is perhaps not the best that could have been made: the beds so named do not occur at Punta Casamayor but especially at Cañadón Tournouër of Ameghino, = Cañadón Lobo of the local inhabitants, a few miles from Casamayor, and so far as I can determine not one of Ameghino's scores of type specimens from this formation came from this locality or even this general region. But these considerations, not very serious in any case, only oppose the giving of such a name *de novo* and do not weigh against its acceptance once it is in wide use. The name Casamayor is already in general use for these beds and is the most satisfactorily established. It certainly should be accepted and the formation called Casamayor, Casamayorian, or Casamayorens. Casamayorens, it may be noted, is understood as used by Frenguelli, not by Kraglievich who confines it to the more or less hypothetically separated upper division and uses Casamayorana for the whole formation.

The nomenclatural situation regarding the beds between the Salamanca and the Casamayor is very unsatisfactory, reflecting, in part, the even less satisfactory knowledge of the stratigraphic and faunal rela-

¹To the objections already expressed against the use of the broader names "Deseadoana" Kraglievich or "Deseadiano" Frenguelli, may be added that these are not, like Loomis' emendation, restricted and more exact definitions of Gaudry's term but applications of about the same breadth but of different content, including in each case more at the bottom and less at the top than did Gaudry—changes of rather doubtful value.

tions of these beds. This horizon was called "Notostylopéen basal" by Ameghino, at least in part, although he probably did not fully recognize its extent and nature and did not limit it in quite the same way as will be done here. Windhausen (1924) called these the "Estratos con dinosaurios, Sección superior," typical of several students who consider these strata, as a whole, to be merely the upper part of a Cretaceous terrestrial series locally and more or less incidentally cut off by a marine intercalation, the Salamanca. With much the same idea, Feruglio (1929) and others, especially the government geologists of the Dirección General de Yacimientos Petrolíferos Fiscales, called these beds the Pehuenche, and this has become the most usual name. Despite this common use, the name Pehuenche is certainly inapplicable to this series.

The very complex history of this name "Pehuenche" is not here wholly pertinent. It suffices to say that the name was proposed by Doering (1882), the type locality being Roca, in Río Negro, and along the banks of the Río Negro to the confluence of the Ríos Limay and Neuquén. As subsequently applied in this region, the name, if used at all, has come to be limited to a dinosaur-bearing series immediately underlying the marine Roca Formation, unquestionably of Cretaceous, and not latest Cretaceous, age. Ameghino extended this name to include also central Patagonian beds, which he considered synchronous with those to the north, immediately underlying the Salamanca, also of certainly Cretaceous age, Senonian or slightly earlier.¹ Essentially this same arrangement was followed by Stappenbeck (1909) with a broader use of the term Pehuenche, and still more recently Feruglio (e.g., 1929) and others have confined the name Pehuenche to the beds *above* the Salamanca Formation and below the Casamayor, as here understood. Now in the first place, actual correlation with the type Pehuenche has not been established, and the sequence is so different that there is some doubt whether the name Pehuenche should be used in central Patagonia at all. In the second place, even if the use of the name Pehuenche in this region be insisted upon, it obviously must be applied only to beds considered synchronous with the type Pehuenche, and it is demonstrably true that at least a large part of the beds so called, above the Salamanca, are not synchronous with the type Pehuenche.

This is recognized, in part, by Frenguelli (1930), who calls this series "Sehuenense." Unfortunately this involves another correlation equally

¹It has been suggested that Ameghino was mistaken in thinking that his central Patagonian Pehuenche underlay the Salamanca. When later writers say that the Pehuenche *overlies* the Salamanca, they are merely making a different (and at least in part erroneous) correlation, and are applying the name Pehuenche in this region to beds definitely different from and younger than those so called by Ameghino.

uncertain. The type locality of the Sehuenense, named by Ameghino, is the Río Sehuen in southern Patagonia. These deposits remain very poorly known. It is probable, but not certain, that they are of late Cretaceous age. They are, *ipso facto*, probably not synchronous with all, and perhaps not with any, of the central Patagonian "Sehuenense" of Frenguelli. In any case the discontinuity of the two deposits, their apparently different conditions of deposition, and the lack of any truly established correlation between them make this use of the name inadvisable if not positively erroneous.

I believe that in places there is terrestrial Cretaceous overlying the Salamanca. This is not proven, and the delimitation of such a horizon, its correlation, and its naming require more definite data than now available. I know that much of the so-called "Pehuenche," "Sehuenense," "Notostylopéen basal," etc., below the Casamayor, is of Tertiary age, has never yielded a trace of dinosaurs and has yielded mammals at several localities over a wide area in southern Chubut. Lithologically these beds are very different from the overlying Casamayor. Faunally, also, there are differences, although as yet these are not exactly definable. These beds have never been given a correctly applicable name, and I therefore propose for them the name Río Chico (Río Chican, Río Chiquense) for the Río Chico del Chubut, in the valley of which these beds are developed. The Río Chico Formation is defined as a series chiefly composed of sandstones and clays (perhaps in part bentonite), immediately underlying the Casamayor Formation (ash and bentonite, little or no sandstone, with the typical "*Notostylops* fauna") and containing a fauna or faunal facies of mammals of Tertiary type, principally not ungulates, of very primitive character and small individual size. The Río Chico Formation overlies the Salamanca or its lateral equivalent, with or without the interposition of a post-Salamanca terrestrial series.¹ In physical character it is not always clearly distinguishable from part of the underlying terrestrial Cretaceous (pre- or post-Salamanca as the case may be) and may consist in part of material remanié from these older beds, but at least in places it tends to be of paler and less variegated color. Its mammalian fossils are generally found in gray sandstones which are rather distinctive. The fauna, which will be described later, appears to be closely related to that of the Casamayor, probably being directly ancestral to the latter, but to consist of distinctive and more primitive species or genera. It is probable that a few of the species

¹The Salamanca itself grades vertically and laterally into beds of essentially fresh-water character and it is by no means clear that the beds properly included under this name are all marine.

described by Ameghino as from the "Notostylopense" were derived from the Riochiquense, which he included under the former designation without specifically recognizing that it contains a mammalian fauna.¹

That part of the central Patagonian stratigraphic sequence here discussed may, then, be designated as follows (in order of superposition):

	Patagonia	} Perhaps partly overlapping in time.
	Colhué-Huapi	
TERTIARY	Deseado	
	Musters	
	Casamayor	
	Río Chico	
CRETACEOUS	_____	{ Possible late Cretaceous beds not yet clearly recognized or defined.
	Salamanca	

¹Since our work, Feruglio (1931) and Piatnitzky (1931) have also announced the discovery (first made by Piatnitzky) of mammals in these beds. Feruglio continues to call the horizon "Pehuenche," and questions whether the "Pehuenche" is Tertiary or Cretaceous. There is no reason for considering the formation in which these mammals occur as other than Tertiary, but it is not, or cannot be called, the Pehuenche. Piatnitzky, on the other hand, distinguishes these mammal beds (without naming them) from the supposedly underlying "Pehuenche propiamente dicho," but believes them to be probably Cretaceous. From the nature of their fauna and other considerations this seems impossible to me. Fossils are scarce and not very well preserved, but we have enough to describe a typical fauna, to be published later.

REFERENCES

- AMEGHINO, C. 1899. [Letter published in Ameghino, F. 1903.]
- AMEGHINO, F. 1902. 'Cuadro sinóptico de las formaciones sedimentarias terciarias y cretáceas de la Argentina en relación con el desarrollo y descendencia de los mamíferos.' *An. Mus. Nac. Buenos Aires*, VIII [(3) I], pp. 1-12.
1903. 'L'âge des formations sédimentaires de Patagonie.' Coni Frères, Buenos Aires. [Separate edition of articles published serially in *An. Soc. Ci. Argentina*, L and LIV.]
1906. 'Les formations sédimentaires du crétacé supérieur et du tertiaire de Patagonie avec un parallèle entre leurs faunes mammalogiques et celles de l'ancien continent.' *An. Mus. Nac. Buenos Aires*, XV [(3) VIII], pp. 1-568.
- CABRERA, A. 1927. 'Datos para el conocimiento de los dasiuroideos fósiles argentinos.' *Rev. Mus. La Plata*, XXX, pp. 217-315.
- FERUGLIO, F. 1929. 'Apuntes sobre la constitución geológica de la región del Golfo de San Jorge.' *An. Soc. Arg. Estud. Geog. "GAEA,"* III, pp. 395-486.
1931. 'Nuevas observaciones geológicas en la Patagonia central.' *Direc. Gen. Yac. Petrol. Fisc., Cont. 1^{ra} Reun. Nac. Geografía*, Buenos Aires, No. IV, pp. 1-24.
- FRENGUELLI, J. 1930. 'Nomenclatura estratigráfica patagónica.' *An. Soc. Ci. Santa Fé*, III, pp. 1-117.
- GAUDRY, A. 1906. 'Fossiles de Patagonie. Étude sur une portion du monde antarctique.' *An. Paleont., I*, pp. 101-143. [Also paged serially, pp. 1-43.]
- KRAGLIEVICH, L. 1930. 'La formación friaseana del Río Frías, Río Fénix, Laguna Blanca, etc. y su fauna de mamíferos.' *Physis*, X, pp. 127-161.
- LOOMIS, F. B. 1914. 'The Deseado Formation of Patagonia.' *Amherst College, Amherst, Mass.*
- PIATNITZKY, A. 1931. 'Observaciones estratigráficas sobre las tobas con mamíferos del Terciario inferior en el Valle del Río Chico (Chubut).' *Bol. Inf. Petrol., VIII*, No. 85, pp. 1-16.
- ROTH, S. 1908. 'Beitrag zur Gliederung der Sedimentablagerungen in Patagonien und der Pampasregion.' *Neues Jahrb. Min., Geol., Paläont., Beil. Bd. XXVI*, pp. 92-150.
- SIMPSON, G. G. 1932. 'The supposed association of dinosaurs with mammals of Tertiary type in Patagonia.' *Amer. Mus. Novitates*, No. 566, pp. 1-21.
- TOURNOUER, A. 1903. 'Note sur la géologie et la paléontologie de la Patagonie.' *Bull. Soc. Géol. France*, (4) III, pp. 463-473.
- WINDHAUSEN, A. 1924. 'Líneas generales de la constitución geológica de la región situada al oeste del Golfo de San Jorge.' *Bol. Ac. Nac. Ci. Córdoba*, XXVII, pp. 167-320.

AMERICAN MUSEUM NOVITATES

Number 645

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

July 18, 1933

55.26

LIVING BACTERIA IN ANCIENT ROCKS AND METEORITES

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The recent newspaper publicity accorded the investigations of Lipman on "Are there Living Bacteria in Stony Meteorites?"² cannot but be disturbing to the minds of earnest searchers for truth, especially when the supposed findings fail of corroboration in other laboratories.

Professor Lipman's technique and interpretation are open to serious question, as had already been indicated by investigators who failed to verify his "discovery" of bacteria in anthracite coal. A brief review of the work on living organisms in ancient rocks and in meteorites may help to clarify some of the misconceptions that have taken root in the minds of the reading public as a result of the broadcasting of such engrossing observations.

The possible occurrence of bacteria in ancient rocks has been suggested before. European investigators (Galle in 1910-1911, Schroeder in 1914, and Lieske and Hoffman in 1929) carried on various studies to determine whether the bacteria found were responsible for the production of coal gas in the mines, and at what depth of the earth's crust bacteria may actually be recovered. Lipman very briefly reported (*Science*, 1928) the finding of bacteria in pre-Cambrian rock. This was followed by a report of his "discovery" (*Journ. Bact.*, 1931) of bacteria in anthracite coal, in which he claimed that these bacteria had existed in the coal since the time of its formation, a matter of millions of years, depending on the geological time-table used. Farrell and Turner (*Journ. Bact.*, 1931) attempted to verify Lipman's findings on coal, but were unable to do so except in coal that was fractured and had become infiltrated with bacteria as a result of the seepage of surface and mine water. The micro-organisms found in this cracked coal, and in the mine water and mine soil, were apparently identical with those described by Lipman, and were such as are commonly found in air, soil and water. No bacteria were found in coal that was not fractured or cracked.

In December, 1932 (*American Museum Novitates* No. 588) Lipman reported the finding of living bacteria in stony meteorites, having

¹Department of Bacteriology, Yale University, New Haven, Connecticut.

²Lipman, Chas. B., 1932, *Amer. Mus. Novitates*, No. 588.

followed essentially the same technique as in his previous work. These micro-organisms are regarded by him as inhabitants of another planet.

In any bacteriological investigation of this kind, a large part of the emphasis should be placed, not only upon the objects sought, but upon preventing bacteria, yeasts and moulds that are present in the air, and all objects exposed to air, dust, water, etc., from gaining entrance to the material under study. The technique employed by Lipman in the preparation of glassware and culture media was, without doubt, beyond reproach. It is not so apparent that the surface of the various meteorites was actually freed from all foreign bacteria, and that the crushing and the handling of the powdered meteorites were carried out aseptically. Lipman attempts to answer these anticipated rejoinders in a positive vein, claiming that the utmost precautions were used in conducting this part of the investigation.

Lipman's work is divided into three parts. In his review of the third and final group of experiments he states that all foreign living micro-organisms were removed from the surface of the meteorite, and that the meteorite was then crushed and the crushed material inoculated into sterile culture media.

In the crushing and handling of the ground material there was every possibility of contamination. Prevention of contamination of the meteorites during the process of crushing alone must appear to trained bacteriologists as an almost insurmountable task. The author states (page 17) that, after perfecting the sterile procedure used in his final set of experiments, upon which, we must assume, his main emphasis and interpretation are based, some foreign bacteria were found as contaminants. If such contamination was possible, after all the aseptic precautions that were taken, is it not also possible that all of the bacteria observed were contaminants?

Aside from the above considerations, would it necessarily follow that, if bacteria did perchance exist in meteorites, they had come down from the skies? Is it not possible that they might have gained entrance after reaching the earth? Lipman anticipates this question, and answers it by declaring that one of the sixteen meteorites had little or no contact with the earth, and that this statement invalidates such a criticism. This must appear to everyone as a strange form of logic. Since only one meteorite is claimed to have had little or no contact with the earth, how can his statement invalidate such a criticism against the other fifteen meteorites, upon which over 90% of his work is based. An inquiry into the history of the sixteen meteorites used in this work reveals that they

were found between 1868 and 1924; several of them have no definite age history. It is not known when the meteorites fell; the available records show only when they were picked up. In any event, these meteorites have been in contact with the earth during an unknown interval of time, and have been exposed to the air and to weathering from 8 to 65 years, at least. The weathering involved contraction and expansion which would provide an easy means of ingress for bacteria and other micro-organisms. This weathering could occur in a museum as well as outside. Dust, dirt and water may have carried bacteria into fissures in these as well as in other rocks. The cracks containing bacteria may have become sealed over during later weathering processes and remained closed for a long period of years. The treatment of the surface with disinfectants would not necessarily kill the bacteria in the sealed cracks.

The situation regarding the alleged presence of living bacteria in meteorites is but little different from that which concerns bacterial life in anthracite coal. Living bacteria are of common occurrence in soil, air and water. One sample of anthracite coal examined by Lipman was obtained for him from a mine in Pennsylvania, 3,000 miles distant from his laboratory, and his ambitious interpretation was made without his having seen the mine or having any definite knowledge of the geological formation of the area. In this work on meteorites, spectacular interpretations are again made when little or nothing is known concerning the past history of the meteorites studied. Until such interpretations are based on much more convincing and fool-proof observations, Lipman's excursions into the field of life beyond this globe must be considered as a flight of imagination through space.

AMERICAN MUSEUM NOVITATES

Number 646

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

July 19, 1933

59.88, 6 T (85)

STUDIES OF PERUVIAN BIRDS. IX¹

THE FORMICARIAN GENUS *THAMNOPHILUS*. PART I

BY JOHN T. ZIMMER

I am greatly indebted to Dr. C. E. Hellmayr for observations on certain material in Vienna not accessible to me for present study. I am also under obligations to Mr. W. E. C. Todd of the Carnegie Museum, Pittsburgh, for the loan of certain specimens used in the account.

Thamnophilus doliatus subradiatus Berlepsch

Thamnophilus subradiatus BERLEPSCH, 1887, Journ. Orn., XXXV, p. 17—obern Amazonas (Yquitos, etc.)=Iquitos, Perú; ♂; Berlepsch Coll., Frankfort Museum.

Thamnophilus variegaticeps BERLEPSCH AND STOLZMANN, 1896, P. Z. S. London, p. 379—La Merced, Chanchamayo, Perú; Frankfort Museum and Warsaw Museum.

Forty skins from various parts of Perú demonstrate the extreme variability of this bird. With one or two selected skins from different parts of the country it would be possible to point out certain differences and separate several subspecies, but the more material that is examined, the less constant these variations appear.

Typical examples from Puerto Indiana, a little east of Iquitos, are relatively dark in both sexes. The males are rather narrowly barred with white on the back and have the black and white bands of the under parts about equal in width. The forehead is moderately widely marked with whitish scratches and the median line of the crown has some traces of white on the margins or bases of the feathers. In the occipital region, the shorter plumes of the crest have a pair of rather large, rounded, white spots on each, sometimes nearly meeting at the shaft. Young males, which may lack the white on the crown, show this occipital character well.

A female from this region has the upper and under parts somewhat deeper in tone than they are in skins from other parts of Perú except the southeast. Two females from Jaen, middle Marañón, are, however, almost as dark and whatever may be done with skins from other regions, these, I believe, must go with typical *subradiatus*.

¹Earlier papers in the series comprise American Museum Novitates Nos. 500, 509, 523, 524, 538, 545, 558, and 584.

A number of skins from the Chanchamayo Valley are inclined to average paler than the Puerto Indiana and Jaen examples. The males have the white bars of the back slightly wider and, perhaps, purer white; the throat may be more lightly streaked, and the rest of the under parts have the white bars rather wider than the black ones which latter are somewhat duller and not so deeply black as in typical *subradiatus*. The females are a little less deeply rufous on the cap, correspondingly paler on the back, and still paler below, sometimes buffy rather than ochraceous. Some females, however, are almost as dark as the Jaen examples. Two females from Moyobamba (in Field Museum of Natural History) are paler than one from the Chanchamayo region, with which I compared them, and two males (one immature) from Moyobamba have more extensive white than two Chanchamayo males.

The original description of "*variegaticeps*" notes the crest as having white markings on the median plumes, but this is not the case in the males at hand. The white dorsal bars are said to be wider in "*variegaticeps*" males than in *subradiatus* males, and I have already mentioned that there is a tendency in this direction.

One male from La Merced is peculiar in that the black bars of the under side are noticeably wider than the white ones, which brings its appearance very close to that of typical *subradiatus*, though the dorsal bars are clearer white and black than in the Puerto Indiana specimens.

A few skins from the Urubamba Valley are again different. The males have even more white below than the Chanchamayo skins and one of them, from Santa Ana, has very extensive white basally along the middle line of the crown. In general appearance the males from this region are very like others from the Rio Madeira, Brazil, but the females are not clearly different from the Chanchamayo females. This is particularly significant in view of the fact that Berlepsch and Stolzmann (Ornis, XIII, p. 93, 1906) refer six specimens from Santa Ana to the supposedly darker *subradiatus* rather than to the supposedly lighter "*variegaticeps*."

Skins from the Ucayali Valley are as variable as those from the other regions. Some of the males are darker than those of typical *subradiatus*, with narrow white bars on the back, no white on the median line of the crown, reduced white on the forehead and the occipital region, and decidedly reduced white on the lateral margins of the tail and wings. One male from Santa Rosa has the white very markedly reduced on the wings and tail, but another male from the same locality has the white as broad as in the Chanchamayo birds; a male from Sarayacu has an intermediate amount of white on the tail and wings but the white bars of the back are reduced to very narrow lines.

Females from the Ucayali are rather pale, like those of "*variegaticeps*," with the forehead a little more buffy than the crown (whereas in other *subradiatus* crown and forehead are more uniform). Thus, while the males are often darker than those from the Chanchamayo region and possibly reach the darkest extreme of *subradiatus*, the females are relatively pale.

Nevertheless, Taczanowski ('Orn. Pér.,' II, pp. 19-21, 1884) assigns some Sarayacu material to *doliatus* and other specimens to *radiatus*, which argues for some degree of variation in this region.

Two males and a female from Teffé, Brazil, are fairly close to the Ucayali series, and a female from Orosa, Perú, is likewise similar. The Teffé males have a little more white in the markings than the darker Ucayali males, but not so much as the palest of them.

The dark coloration of the Puerto Indiana female is of doubtful value since an extensive series of females of a closely related form on the Rio Madeira shows a range of variation covering both extremes.

As in the case of *T. palliatus berlepschi* (cf. p. 13), young males may have the white markings unduly emphasized. Thus, a young male from Jaen and another from the mouth of the Curaray, eastern Ecuador, have more extensive white both above and below than adults from Puerto Indiana and are like Chanchamayo males. A young male from Anayacu is no lighter than usual above but the black bands on the breast tend to stop short of the lateral margins of the feathers and thus often form lunules rather than bars. All three of these young birds have the crest well developed but without any decided amount of white on the median feathers.

A male and a female from Astillero, southeastern Perú, are both very dark. The female is so richly colored as to match Rio Madeiran females almost as closely as north-Peruvian ones, though there is more of light auburn than of chestnut in the tone of the back, as in true *subradiatus*. The position of Astillero on an upper affluent of the Rio Madeira drainage makes the association with the Rio Madeira plausible, so far as the female is concerned. The male, however, being equally very dark, agrees with dark Ucayali birds but not at all with Rio Madeiran ones. Therefore, in spite of the geographic situation of Astillero on the drainage of the Rio Madeira, birds from southeastern Perú may be left with *subradiatus*.

Localities in Perú, other than those in the subjoined list of specimens examined, from which *subradiatus* is known, are Nauta, Pebas, Iquitos, Samiria, Bellavista, Amable Maria, Monterico, San Miguel Bridge, Huiro, and Maranura.

Skins from northern Bolivia and northwestern Matto Grosso, Brazil, do not agree exactly with any of the known forms and yet do not appear to form a distinct group. The males are relatively paler than typical *subradiatus*, agreeing better with the birds from the Chanchamayo and Urubamba regions, but the females are decidedly dark and agree rather well with that sex of *difficilis*; the males are not quite so pale as *difficilis*, with less white on the forehead.

On the lower Amazon, from the left bank of the Madeira to the right bank of the Tapajoz, it is possible to distinguish a fairly well-marked form. The males usually have the white bars of the back decidedly broader than in *subradiatus* (though slightly narrower than in *capistratus*) and the under parts more extensively whitish, relatively unmarked on the abdomen; the crest is rather short, and the forehead is only moderately marked with white, never as strongly as in *difficilis*. The females are quite deeply colored, averaging darker than *subradiatus*. These birds are closer to *difficilis* than to *subradiatus*, but the males have the barring of a bolder pattern than in either of the other forms. None of the males are as dark as the darkest *subradiatus*, but some of them approach the paler examples of the east-Peruvian form.

Our skins from Faro (Rio Jamundá) and Igarapé Cacao Pereira (Rio Negro), north of the Amazon, unquestionably do not belong to typical *doliatus* (which, however, reaches the Amazon at Marajó Island) but are inseparable from this south-bank form. A hint of the same situation is found in Hellmayr's note accompanying his original description of *difficilis* where a male from Obidos is assigned to *difficilis* though later (1924), it was transferred by Hellmayr to *doliatus*. There are other records of *doliatus* from Faro, Obidos, and Monte Alegre, and possibly certain skins from that region may resemble the Guianan form. Those at hand certainly are not of that subspecies.

A single male from Marajó has the black and white barring of both upper and under parts wider than in the Guianan skins of *doliatus* at hand, being better matched in certain Venezuelan specimens of *fraterculus*, but, in any case, the white of the crown is too extensive to permit association with the new form. A female from Marajó has a more whitish throat than the true *doliatus* females at hand and, except for a shorter crest, much resembles females from Maranhão, of which more will be said later.

The new form may be characterized as follows:

***Thamnophilus doliatus signatus*, new subspecies**

TYPE from Santarem, Rio Tapajoz, Brazil. No. 288,508, American Museum of Natural History. Adult male collected August 13, 1931, by A. M. Olalla.

DIAGNOSIS.—Similar to *T. d. subradiatus* of upper Amazonia, but males with dorsal white bars decidedly broader; throat with narrower white streaks; breast, sides, and flanks with white bars broader and clearer (but black bars not reduced as in *radiatus*); belly with black bars less distinct, sometimes partially obsolete; under wing-coverts more extensively white. Females with coloration warmer in tone.

RANGE.—South bank of the Amazon from the left bank of the Rio Madeira eastward to the right bank of the Tapajoz, crossing to the north bank of the Amazon at the mouths of the Jamundá and Negro, and apparently ascending the Madeira and its tributaries to northern Matto Grosso and northern Bolivia.

DESCRIPTION OF TYPE.—Top of head crested, black, with the feathers of the forehead and superciliary region margined laterally with faintly grayish white; hind neck with a small whitish spot on each margin of the feathers; back black with two or three white bars (about 1.5 mm. wide) on each feather, separated by black interspaces about 5 mm. wide; a little suggestion of a silky white patch concealed on the mantle; upper tail-coverts black with white bars more or less interrupted at the shaft. Lores grayish white with some blackish at tips; sides of head and neck with black shaft-stripes and wide white margins; chin and throat white with narrow sooty shaft-lines; breast, sides, and flanks white with black bars about 1 mm. wide separated from each other by interspaces of white from 2–3 mm. in width; belly white, with dark bars much narrower and less distinct; thighs black with white margins and shaft stripes; under tail-coverts white, with dark bars distinct; under wing-coverts white, nearly immaculate except near radial margin; axillaries with more or less distinct bars. Wings blackish, with large quadrate or triangular white spots on both inner and outer margins of the remiges; upper wing-coverts with similar marginal spots, the distal pair on the various feathers meeting to form a continuous subapical band. Tail black with seven to eight pairs of large marginal spots of white. Maxilla black (in dried skin); mandible light slate; feet dark slate. Wing, 76 mm.; tail, 63; exposed culmen, 17.5; culmen from base, 22; tarsus, 26.5.

REMARKS.—Females with crest chestnut; back Burnt Sienna x Sanford's Brown¹; hind neck more or less indistinctly streaked with dusky; lores buffy; sides of head and superciliary stripe with blackish shaft-stripes and ochraceous or buffy margins; throat rather deep ochraceous, sometimes with narrow blackish hair-lines on shafts; rest of under parts much richer, tawny-ochraceous-buff. Wings and tail light Chestnut x Auburn; inner margins of remiges light cinnamomeous; under wing-coverts ochraceous-buff. Wings, 72–75 mm.; tail, 59–65.

The association of this new form with the inhabitants of the upper Rio Madeira and its affluents in northern Matto Grosso and northern Bolivia is not unquestionable. A perfect transition is observable between the Tapajoz skins through the Madeiran series to the north-

¹Names of colors when capitalized indicate direct comparison with Ridgway's 'Color Standards and Color Nomenclature.'

Bolivian specimens; as mentioned earlier, a female from southeast Perú could be placed in this series without comment if a male from the same region was not better in accord with true *subradiatus*. The Paraguayan subspecies, *radiatus*, is found also in Bolivia and Matto Grosso, southern Brazil, but it is restricted to rivers with a southward flow, the Paraguay and Paraná, while the new form does not cross the watershed but inhabits the valleys of the Madeira and Tapajoz which flow northward into the Amazon.

The Goyaz form, *difficilis*, is also on the northern slope of this watershed. It would appear to range northward to the state of Maranhão, for Hellmayr (1929) identifies various Maranhão skins as his *difficilis*. Such Maranhão and northwestern Piahy specimens as I have at hand do not support this allocation as well as I would like and are different from a pair of Goyaz skins that must be *difficilis*. The Maranhão males are unusually extensively white above and below; the crest is exceedingly long and full but without much medial white. The females are paler than the Goyaz female and have the crest (as in the males) exceedingly long and full. Without seeing more material from Goyaz, it is difficult to say what distinctions, if any, may be constant in this region.

I am unacquainted with the form, *novus*, described from western São Paulo.

***Thamnophilus doliatus zarumae* Chapman**

Thamnophilus zarumae CHAPMAN, 1921, Amer. Mus. Novit., 18, p. 6—Zaruma, Prov. del Oro, W. Ecuador; ♂; Amer. Mus. Nat. Hist.

One male from Milagros, northern Piura, Perú, agrees closely with the type and other specimens from southwestern Ecuador. Ten birds of both sexes from the southern part of the Province of Piura are, however, noticeably different and deserve separation as follows.

***Thamnophilus doliatus palambiae*, new subspecies**

TYPE from Palambia, Department of Piura, Perú, altitude 3900–6500 ft. No. 175,251, American Museum of Natural History. Adult male collected September 19, 1922, by Harry Watkins; original number 6082.

DIAGNOSIS.—Similar to *T. d. zarumae* Chapman of southwestern Ecuador and the northern part of the Department of Piura, Perú, but males with the upper part of the mantle and the inner scapulars strongly olivaceous gray with few, if any, white or black markings; most anterior of the white markings on mantle small and rounded and with less extensive black markings surrounding the white; white marks on rest of mantle duller, less pure white and inclined to form lunules or spots rather than broad bars; rump deeper and more brownish olive with less prominent barring; median portion of upper tail-coverts olivaceous; white marks on lateral feathers of the crest and on the nape not so broad nor distinct; lores duller, less purely white;

throat tinged with buff and with dark streaks less distinct; breast also tinged with buff and with dark bars duller, less blackish and less distinct; belly more buffy and flanks and crissum more strongly ochraceous; outer margins of remiges more strongly grayish and with white spots usually smaller. Females darker above; top of the head darker rufous than in *zarumae*; upper part of mantle and inner scapulars more brownish olive and less rufous; rump browner; flanks averaging deeper ochraceous; middle of belly more buffy, less whitish.

RANGE.—Southern part of the Department of Piura, Perú, in the neighborhood of the upper Río de Piura.

DESCRIPTION OF TYPE.—Top of head black; feathers of forehead with marginal spots of dull whitish; a broad superciliary stripe similarly marked; crown and occiput crested, with lateral feathers having a more or less distinct whitish spot on outer margins; nuchal feathers with a small whitish spot on both margins; hind neck grayish, with dusky subterminal areas and traces of whitish spots on the margins; upper mantle and inner scapulars Grayish Olive to Light Grayish Olive; remainder of mantle and outer scapulars with alternating black and white bands, the distal white mark of each feather somewhat lunulate; in the area immediately following the olive-colored region of the anterior mantle, the white spots are small and rounded and only narrowly bordered by black; slight suggestions of a concealed patch of silky white on middle of some mantle feathers; lower back marked like mantle but pale areas are tinged with Grayish Olive; rump Light Brownish Olive to Isabella Color; upper tail-coverts terminally barred with black and white, but median portion tinged with buffy olive. Lores whitish, faintly buffy, with black, hair-like tips; auriculars and malar region white with suggestions of dusky bars or streaks; chin and throat buffy whitish with broad gray bases and dull brownish subterminal spots, not very conspicuous; breast and sides also slightly buffy with two or three dusky bars on each feather, dull and not sharply outlined; belly whitish buff; flanks and crissum a little darker than Chamois, with the upper flanks duller and indistinctly barred with dusky; the longest under tail-coverts more strongly barred. Tail graduated, outer rectrices 14 mm. shorter than middle ones; black with seven pairs of marginal white spots, the distal pair almost meeting at shaft. Wings sooty black with outer margins dark gray, widest basally, and with a row of small whitish spots spaced in the gray border which is inclined to blackish immediately around the white spots; upper wing-coverts blackish with white or buffy bars; inner margins of remiges white except distally, occasionally broken into spots by the crenate margin of the darker median portion of the webs; under wing-coverts pale buff. Bill blackish (in dried skin), mandible paler; feet slaty. Wing, 70 mm.; tail, 62.5; exposed culmen, 15; culmen from base, 20; tarsus, 26.

REMARKS.—Females have the top of the head crested, Auburn to Chestnut; forehead grayish buff; lateral crest-feathers somewhat ochraceous on outer margins; superciliary stripe, sides of neck, and hind neck with dusky shaft-stripes and dull, buffy grayish margins; upper part of mantle nearly Light Brownish Olive; inner scapulars similar but slightly more rufescent; rump warm Dresden Brown; rest of back deep Sanford's Brown with an obsolete dusky subterminal spot and with some traces of a pale Ochraceous-Salmon spot at the shaft in the median area.

Lores pale, dull buff; sides of head as in the male but more buffy; chin and throat light ochraceous buff with the markings of the male sub-obsolete; breast and sides deeper than throat and with obsolete darker bars; belly light buff; flanks and crissum deep Clay Color, lighter on upper flanks. Tail light Auburn with varyingly distinct traces of dark bars, more distinct subterminally; wings dull blackish with outer margins of remiges light Auburn, those of inner remiges varied on occasion by dusky spots; inner margins pinkish buff except at tips; greater and median upper wing-coverts Auburn x Sanford's Brown with dusky bars; lesser coverts more olivaceous with a buffy spot near tip; under wing-coverts pale ochraceous buff. Bill and feet as in male. Wings, 67-71 mm.; tail, 62-66; exposed culmen 14.75-15; culmen from base, 20-21; tarsus, 26-27.

At first glance, the specimens from Palambla suggest the assumption that they are immature examples of *zarumae* but various examples of immature *zarumae* are at hand for comparison and, while easily distinguishable from the adults of that form, do not show the characters which distinguish *palamblae*. The young of both forms are as readily distinguishable as the adults. Immature males of *zarumae* have the upper mantle somewhat tinged with olive, but the barring there and on the inner scapulars is as in adult *zarumae* and not reduced or obsolete. The under parts in young *zarumae* are more buffy than in the adults, resembling the color in adult *palamblae* but young *palamblae* are even more richly colored. The barring on the chest is alike in young and adults of either form, much reduced in *palamblae*. Many of the specimens of *zarumae* were taken in September as were all of the skins of *palamblae*, so the series are quite comparable in regard to season. A certain amount of geographical separation appears to exist to add to the bases for the distinction of the new form.

SPECIMENS EXAMINED

T. d. doliaetus.—DUTCH GUIANA: Paramaribo, 1♂, 1♀. FRENCH GUIANA: Approuague, 1♂, 1♀. BRAZIL: Ilha Marajó, Chaves, 1♂, 1♀; Rio Surumú, Frechal, 3♂; Rio Branco, Caracahy, 1♀.

T. d. capistratus.—BRAZIL: Bahia, Baita, 1♂, 1♀; Piahy, Parnagua, 3♂, 1♀, 1?

T. d. difficilis.—BRAZIL: Goyaz, Rio Araguaya, 1♂, 1♀; Piahy, Therezina, 2♂; Os Morros, Parnahyba Delta, 1♀; Maranhão, São João dos Patos, 1♂, 1♀; Tabocas, 1♂; Pastos Bons, 1♂; Kelsú, Rosario, 1♂.

T. d. radiatus.—PARAGUAY: Chaco, opposite Concepción, 1♂, 5♀. ARGENTINA: Embarcacion, 3♂, 1♀. BRAZIL: Matto Grosso, Chapada, 8♂, 8♀; Urucum, 5♂, 3♀; Tapirapoan, 2♂, 1♀; Rio São Lorenzo, 1♀.

T. d. signatus.—BRAZIL: Rio Tapajoz, Santarem, 6 ♂ (incl. type), 5 ♀; Rio Amazonas, Villa Bella Imperatriz, 13 ♂, 6 ♀; Rio Jamundá, Faro, 5 ♂, 4 ♀; Rio Negro, Igarapé Cacao Pereira, 4 ♂, 1 ♀; Rio Madeira, Borba, 10 ♂, 4 ♀; Igarapé Auará, 4 ♂; Rosarinho, 14 ♂, 11 ♀; Santo Antonio de Guajará, 1 ♂, 1 ♀; Calamá, 1 ♀; Matto Grosso, Utiarity, 2 ♂, 2 ♀; Juruena, 1 ♀; Agua Blanca de Corumbá, 2 ♂; Tres Buritys, 1 ♂. BOLIVIA: Trinidad, Río Mamoré, 1 ♀; Todos Santos, 2 ♂, 2 ♀; Falls of the Río Madeira, 1 ♀; "Bolivia" (Rusby), 1 ♀; Reyes, 1 ♂; "Yungas, 18° S.," 1 ♂.

T. d. subradiatus.—PERÚ: Astillero, 1 ♂, 1 ♀; Santa Ana, Urubamba Valley, 2 ♂, 1 ♀; Chauillay, 1 ♀; foot of Machu Picchu, 1 ♂; La Merced, Junín, 3 ♂, 4 ♀; Perené, 1 ♀; Río Colorado, 2 ♂¹, 1 ♀¹; Tulumayo, 2 ♂; Santa Rosa, upper Ucayali, 2 ♂, 1 ♀; Lagarto, 1 ♀; mouth of Río Urubamba, 1 ♀; Sarayacu, 1 ♂; Orosa, Río Amazonas, 1 ♀; Puerto Indiana, 3 ♂, 2 ♀; Anayacu, 1 ♂; Jaen, 1 ♂, 2 ♀; Moyobamba, 2 ♂¹, 2 ♀¹. ECUADOR: mouth of Río Curaray, 1 ♂. BRAZIL: Tefé, 2 ♂, 1 ♀.

T. d. palamblae.—PERÚ: Palambla, 6 ♂ (incl. type), 4 ♀.

T. d. zarumae.—PERÚ: Milagros, 1 ♂. ECUADOR: Zaruma, 1 ♂ (type), 4 ♀; Portovelo, 6 ♂, 5 ♀; Alamor, 3 ♂, 1 ♀; Lunamá, 1 ♂; Guainche, 1 ♂, 1 ♀; Las Piñas, 1 ♂, 4 ♀; Punta Santa Ana, 1 ♂; Celica, 1 ♀; Cebollal, 1 ♀; Río Pindo, 1 ♀.

Thamnophilus palliatus similis, new subspecies

TYPE from Chelpes, Junín, Perú, altitude 7300 feet. No. 169,681, American Museum of Natural History. Adult male collected April 27, 1921, by Harry Watkins.

DIAGNOSIS.—Similar to *T. p. palliatus* of Bahia, Brazil, but averaging darker below or lighter above and with wing and tail averaging longer, bill averaging shorter. Males with narrower and less purely white margins on the feathers of the throat; with the light portion of most of the under wing-coverts, except the primary series, whiter and less ochraceous, in greater contrast to the primary-coverts; and with the outer pair of rectrices without any trace of a subterminal dusky spot; crest a little longer, concealing more of the white dots on hind neck. Females with uropygium more nearly the color of the back; hind neck less extensively banded; crest slightly longer; a less noticeable collar of dusky-barred feathers on hind neck; cap less contrasting with mantle; under wing-coverts with primary series more ochraceous than the remainder.

RANGE.—Central Perú from the Chanchamayo Region northward to the upper Huallaga Valley, in the upper Tropical Zone.

DESCRIPTION OF TYPE.—Top of head black with fine, white, marginal spots on many of the feathers, more abundant on forehead, superciliary region, and hind neck but present also on some of the elongated feathers of the crest; back between Chestnut and Burnt Sienna, with an ill-defined area separating the mantle from the hind neck, somewhat barred with black and pale rufous, forming a transition zone; lowermost uropygial feathers terminally barred with black and white or blackish and dull ochraceous, these barred feathers somewhat concealed under the rufous tips of the overlying feathers; upper tail-coverts uniform rufous like the mantle. Lores black, with whitish subterminal bars; auriculars like forehead; sides of neck similar with

¹Specimens in Field Museum of Natural History, Chicago.

whitespotting a little larger; chin and throat black with narrow grayish central stripes; rest of under parts of body barred regularly with black and white, the black portions being broader than the white; flanks and thighs somewhat strongly rusty. Wings externally like the back; under primary-coverts pale ochraceous, dusky at tips, whitish just before tips, and crossed by two dusky bands, of which the more basal one is not pronounced; rest of under wing-coverts whitish, narrowly banded with blackish; inner margins of remiges dark Orange-Cinnamon. Tail like back or a little darker. Bill and feet blackish (in dried skin). Wing, 79 mm.; tail, 67; exposed culmen, 16; culmen from base, 22; tarsus, 24.

REMARKS.—Female slightly paler on the back than the male, near Sanford's Brown, and with top of head also rufous, slightly darker than the back; lower uropygial feathers less distinctly barred, under parts lighter than in the male, with the white bars slightly wider than the black ones and the white margins of the throat-feathers similarly a little broader; under wing-coverts ochraceous, barred with blackish, but the primary-coverts much deeper in color than the remainder; under tail-coverts, thighs, and flanks rather strongly rusty. Wings, 71–75 mm. (av. 73); tail, 60–66 (av. 63.38); exposed culmen, 16–18 (av. 16.8); culmen from base, 20–21 (av. 20.75); tarsus, 23–26 (av. 24.2).

Males in the series show the following measurements: wings, 73.25–79 mm. (av. 76.59); tail, 65–74 (av. 68.50); exposed culmen, 15.5–19 (av. 17); culmen from base, 21–23 (av. 21.8); tarsus, 23–25 (av. 24.4.).

The similarity of this form to typical *palliatus* of Bahia is very striking and were it not for the fact that *puncticeps* of Bolivia and south-eastern Perú intervenes between the ranges of *palliatus* and *similis*, the slight differences noted might lose their significance. In its generally accepted range, *palliatus* is not perfectly constant and skins from southern Bahia, Rio, and Espirito Santo are inclined to be paler rufous above, lighter below, and with more strongly ochraceous under wing-coverts, approaching, in these respects, *puncticeps*, which is discussed below.

When the back is dark as in *similis*, the under parts remain noticeably lighter, and often both upper and under parts are lighter in tone. If separable, this form probably should be called *vestitus* Lesson, based on *Thamnophilus lineatus* Spix (*nec Vieillot*), the type male of which is said by Hellmayr (Abh. Bay. Akad. Wiss., 2 Kl., XXII, No. 3, p. 655, 1906) to be a little less blackish below than Bahia skins. The name *badius* Swainson is probably a synonym of *vestitus*; the original plate agrees better with skins from near Rio de Janeiro than with Bahia specimens. In any case, these paler birds are even more distinct from *similis* than are the topotypes of *palliatus*, and whether their characters are sub-specific or merely alter the average range of color in *palliatus*, they

add to the distinction between *palliatu*s and *similis*, supplying either another interposed form or a greater taxonomic difference. Out of eighteen adult males from Brazil examined for the particular purpose, all but one have some trace of a dusky spot on the outer rectrices subterminally, very pronounced in some cases, barely observable in others, but not entirely lacking as in central Peruvian males. Some females and occasional young males may show the same character but it is not always present. In males of *puncticeps* it is variable, being present in some, absent in others.

The color of the flanks and the amount of white spotting on the crown of the males are too variable to be of any service. The measurements of *palliatu*s, however, give further guide to the distinctness of *similis* as may be seen by the following figures from birds of Bahia and Maranhão taken in comparison with the measurements of *similis* given above. Males: wing, 70–74 mm. (av. 72.2); tail, 59–67 (av. 64.4); culmen from base, 21–24 (av. 22.6). Females: wing, 66–72 mm. (av. 69.1); tail, 59–68 (av. 63.33); culmen from base, 20.5–24 (av. 22.3). Thus, while wing and tail average shorter than in *similis*, the bill averages longer. On the other hand, seven males from the right bank of the Tapajoz, which agree with Bahian males in points of size, length of crest, and general heaviness of coloration, fail to show the dusky spot on the outer rectrices except in two skins where it is poorly developed. One of the Tapajoz females has a small mark of this sort but two others do not. They agree with Bahia and Maranhão females in respect to pronouncedly darker cap, short crest, prominent collar of black and white or black and ochraceous bars on the hind neck, rather dull rump, and generally dark back and tail.

The Tapajoz males measure: wings, 71–74 mm. (av. 72.6); tail, 59.5–65 (av. 63.9); culmen from base, 22–23 (av. 22.7). Females: wings, 70–72 (av. 71); tail, 61.5–63 (av. 61.2); culmen from base, 21.25–22 (av. 21.7). The agreement is markedly with the measurements of the Bahia and Maranhão series of *palliatu*s rather than with *similis*, and though the character of the dusky spot on the outer rectrices does not hold, the Tapajoz birds otherwise agree with typical *palliatu*s.

The birds from the upper Huallaga Valley which I referred to *puncticeps* (Field Mus. Nat. Hist. Publ., Zool. Ser., XVII, p. 320, 1930) fall readily into this new form. Records from Garita del Sol, Amable Maria, Auquimarca, San Bartolomé, and Eneñas also belong here, without much question, as do Tschudi's specimens from central Perú,

***Thamnophilus palliatus puncticeps* Sclater**

Thamnophilus puncticeps SCLATER, 1890, 'Cat. Birds Brit. Mus.,' XV, pp. 207, 212—Tilotilo and Consati, Yungas of La Paz, Bolivia; ♂ ♂, ♀; cotypes in British Mus.

Ten skins from southeastern Perú and four from eastern Bolivia are at hand and although none of this material is from the type locality of Sclater's *puncticeps* part of it is from the east and part from the west of the La Paz region and may be expected to show the range of characters across the intervening space which is not unduly extensive.

Compared with birds from eastern Brazil, which represent true *palliatus* (and possibly a separable form, *vestitus*), and those from central Perú, *similis*, the fourteen skins now in question are rather readily distinguishable. The males are darker on the back than *vestitus* but paler below, with the white bands largely wider than the black ones, especially posteriorly. The amount of white spotting on the top of the head is no greater than in the other conspecifics mentioned (except in one immature male from Vermejo, Bolivia) but the white spots on the sides of the head are stronger than in true *palliatus* or in *similis*, being about as in *vestitus*. The other remiges sometimes have a dusky subterminal spot, sometimes none.

The females are decidedly more ochraceous on the under parts than those of *palliatus*, *vestitus*, or *similis*; the barred portion of the hind neck is strongly suffused with ochraceous or even rufous-ochraceous, while it is more whitish in the other forms; the under wing-coverts are buffy ochraceous, much more sparsely speckled with dusky (often only toward the carpal margin) than in the Brazilian and central Peruvian skins; the lower uropygial feathers are only obscurely barred, this area being largely concealed by the rufous tips of the overlying feathers; the lores are distinctly buffy; the top of the head is dark rufous but the back is not greatly lighter. None of the females at hand have any dusky marks near the tips of the outer rectrices.

An adult male from Barão Melgaço, Matto Grosso, and a young male from Porto Velho, Rio Madeira, appear to belong here. The adult male is lighter below than the darkest Peruvian skin of *puncticeps* and equally dark above, which is much too dark for *vestitus*. It is, however, small for the Bolivian subspecies, having the wings 70.5 mm.; tail, 61; culmen from base 23.25. The young bird is not clearly assignable but from a distributional standpoint should be closer to *puncticeps* than to the east-Brazilian forms.

The only previous records of *puncticeps* from Perú are those of two birds from Huaynapata collected by Kalinowski.

***Thamnophilus palliatus berlepschi* Taczanowski**

Thamnophilus berlepschi TACZANOWSKI, 1884, 'Orn. Pér.', II, p. 22—Huambo and Chirimoto, Perú (Stolzmann and Domaniewski claim Chirimoto ♂ as type); Warsaw Mus.

Owing to the extreme similarity of the females of *berlepschi* to those of *palliatus*, *similis*, and *puncticeps*, the close resemblance of the males in the pattern of the head and the under parts, and the geographic continuity of the ranges without interference, I believe that we should consider *berlepschi* as a representative of *palliatus* and its already unquestioned conspecies.

There appears to be much variation in *berlepschi*, and the line between it and *tenuifasciatus* is not very sharply drawn. Taczanowski described the cotypes of *berlepschi* as having the white dorsal bars continuous or in part composed of isolated spots, with the bars on the tail more or less interrupted in the middle. Hellmayr (Field Mus. Nat. Hist. Publ., Zool. Ser., XIII, pt. 3, p. 74, footnote b, 1924) described two males from Huayabamba and Nuevo Loreto as having the bars on the back, secondaries, and tail continuous, not interrupted. In the material at hand, these bars are usually slightly interrupted, sometimes perfectly complete, and in one male from Huarandosa very markedly interrupted, at least on the mantle and the two median pairs of rectrices (though the markings are relatively broad).

Several males from the Río Napo and its upper tributaries must belong to *tenuifasciatus* and are distinguishable from the Peruvian *berlepschi* by having the white markings of the upper surface quite definitely more finely drawn or more widely broken, or both. In none of the adult males are the bars even nearly complete except near the tips of the outer rectrices. The under parts similarly have the white bars reduced in width and the forehead has less pronounced white speckling.

The type of *tenuifasciatus*, from an unknown part of the Río Napo, is an immature male and, though the forehead is very sparsely speckled with white, the bars on the back are broader than in adult males from the Napo region and more nearly complete. In these last respects it agrees fairly well with some adult Peruvian *berlepschi*. Immature *berlepschi*, however, have the white bars even broader and more complete than adults of the same form so that the comparative distinctions of *berlepschi* and *tenuifasciatus* apparently still hold between immature males of the two forms.

A male from the "Macas Region," Ecuador, agrees well with the adult Napo skins (and so also does Domaniewski's description of

"*Thamnophilus chrostowskii*" from Mapoto, which must be synonymous with *tenuifasciatus*), but three adult males from Zamora and vicinity are not to be distinguished from north-Peruvian birds. A single female from Zamora has the inner margins of the remiges darker than in Peruvian females of *berlepschi* in which the relatively light coloration of this region is a distinguishing feature. The single female from the Napo region has these margins darker than in *berlepschi* but has a lighter back, in which respect the Zamora bird is more like *berlepschi*. I believe that the Zamora region belongs in the range of *berlepschi* though at or near its junction with that of *tenuifasciatus*.

I am strongly tempted to include *multistriatus* and *brachyurus*¹ of western and central Colombia, among the conspecies of *berlepschi* and *palliatu*s. The females of *tenuipunctatus* and *multistriatus* sometimes approach each other very closely, and while none of the males of the various conspecies have quite the extent of white spotting that is present on the top of the head in *multistriatus* and *brachyurus*, the character is merely a matter of degree. Two males of *puncticeps* and one of *berlepschi* have some white spotting on every feather of the head, though these spots do not meet across the shaft to form a bar (as, indeed, they do not in some *multistriatus* and *brachyurus*). Other characters are similarly variable, all no more than extreme developments of features found modified in the *palliatu*s group. The only disturbing factor is the supposed occurrence of *tenuipunctatus* at Anolaima (the type locality) where it has never been obtained by recent collectors and which is within the known range of *multistriatus*. Until this almost certain error is corrected, it will be necessary to maintain *multistriatus* as a distinct species.

Records of *berlepschi* in Perú are from Huambo, Chirimoto, Nuevo Loreto, Huayabamba, and the localities given below.

SPECIMENS EXAMINED

*T. p. palliatu*s.—BRAZIL: Bahia, Cajazeiras, 5♂, 1♀; "Bahia," 1♂, 1♀; Maranhão, Santa Filomena, 1♀; Rosario, 1♂, 1♀²; Turry-assú, 1♂², 1♀²; Kelú, 1♂, 1♀; Santa Maria de San Miguel, Rio Guamá, 1♂; Rio Tocantins (right bank), Baíão, 5♂, 3♀; Mocajuba, 2♂.

*T. p. vestitu*s.—BRAZIL: Bahia (south), Verruga, Rio Pardo, 1♂; Espirito Santo, Lagoa Juparaná, 3♂, 3♀; Rio de Janeiro, 1♂; La Raiz, foot of Organ Mts., 3♂, 2♀; "Brazil," 2♂.

¹*T. m. brachyurus* I can recognize by differences of size in the birds from the Cauca Valley and the western slopes of the western Andes as compared with those from the Magdalena drainage. Eight males have the tail measuring 80–84 mm. (av. 82.9) as compared with 85–89.5 mm. (av. 86.1) in six eastern birds. Six females from the west show the tail 58.5–63 mm. (av. 61.1) as compared with 63–71 (av. 66.4) from the Magdalena region. Differences of color are not so apparent though the eastern birds average slightly darker; some are indistinguishable.

²Specimens in Field Museum of Natural History, Chicago.

T. p. puncticeps.—BRAZIL: Porto Velho, Rio Madeira, 1♂; Barão Melgaço Matto Grosso, 1♂. BOLIVIA: Vermejo, Santa Cruz, 2♂, 2♀. PERÚ: Río Távvara, 2♂, 5♀; La Pampa, 1♂; Candamo, 1♂; Río Inambari, 1♂.

T. p. similis.—PERÚ: Tulumayo, Junín, 3♂ (incl. type), 2♀; Chelpes, 1♂; Vista Alegre, 2♂¹, 2♀¹; Huachipa, 2♂¹, 2♀¹; Chinchao, 2♂¹, 1♀¹.

T. p. berlepschi.—PERÚ: Río Seco, west of Moyobamba, 2♂; Uchco, 1♀; Poco Tambo, 1♀¹; Lomo Santo, 2♂, 1♀; Huarandosa, 1♂, 1♀; San Ignacio, 1♀; Jaen, 2♂; Perico, 3♂, 3♀. ECUADOR: Zamora, 3♂, 1♀.

T. p. tenuifasciatus.—ECUADOR: "Napo" (type), 1♂; below San José, 2♂, 1♀; Río Suno, above Avila, 1♂; Oyacachi, 1♂; Macas Region, 1♂.

T. p. tenuipunctatus.—COLOMBIA: Villavicencio, 3♂, 1♀; Mambito, 1♀.

T. m. multistriatus.—COLOMBIA: (Magdalena Valley), 8♂, 6♀.

T. m. brachyurus.—COLOMBIA: (Cauca Valley and west slope of western Andes), 14♂, 7♀.

***Thamnophilus nigrocinereus cryptoleucus* (Ménégaux and Hellmayr)**

Myrmelastes cryptoleucus MÉNÉGAUX AND HELLMAYR, 1906, Bull. Soc. Philom. Paris, (9) VIII, p. 30—Pebas, Perú; ♂; Paris Mus.

The correct disposition of this form has been determined by Todd (Proc. Biol. Soc. Wash., XL, p. 168, footnote, 1927) and Hellmayr (Journ. Orn., Ergänzungsband, II, p. 42, 1929). The material at hand corroborates their findings and also establishes a greater range than has been known heretofore. Specimens are before me from various points on the Ucayali, as far as its source in the junction of the Urubamba and Tambo rivers, and from both banks of the Amazon below the mouth of the Ucayali. Other records from Perú are from Nauta, Pebas, and Iquitos.

The eastward extension of the range in Brazil has been traced by Todd (*loc. cit.*) through São Paulo de Olivença (near the mouth of the Rio Putumayo or Ica) to Ilha Marrecão (in front of Manacapurú), but whether this extension occurs along the south or north bank of the Amazon is not clearly shown. Ilha Marrecão lies east of the mouth of the Madeira, but our skins from the west bank of the Madeira a short distance above its mouth belong to *T. n. tschudii*. The exact boundary between the ranges of these forms has yet to be shown.

Among the allied subspecies, material is available of *T. n. nigrocinereus* from the Tocantins and also from the left bank of the Xingú, a new region for this form, which extends the range westward.

One female of *T. n. cinereoniger* from the mouth of the Río Ocamo on the Cassiquiare, Venezuela, shows an approach toward the grayish dorsum described for *T. n. kulczynskii* of French Guiana which I have not seen.

SPECIMENS EXAMINED

T. n. cryptoleucus.—PERÚ: mouth of Río Urubamba, 1♂; Río Ucayali, Lagarto, 5♂; Santa Rosa, 1♂, 1 "♂" (= ♀?); Sarayacu, 11♂, 8♀, 1 "♂" (= ♀); Río Amazonas, Orosa, "1♂" (= ♀); Puerto Indiana, 1♀.

T. n. tschudii.—BRAZIL: Rio Madeira, Borba, 1 (♂); Santo Antonio de Guajará, 5♂, 3♀.

T. n. huberi.—BRAZIL: Santarem, 1♂.

T. n. nigrocinereus.—BRAZIL: Rio Tocantins, Ilha Itaiuna, 7♂, 7♀, 1 "♀" (= ♂); Baião, 1♀; Arumanduba, 1♀; Rio Xingú, Tapará, 1♂; Villarinho do Monte, 6♂, 4♀.

T. n. cinereoniger.—BRAZIL: Rio Negro, Santa Isabel, 1♂; Santa Maria, 1♂; San Gabriel, 1♀; Tabocal, 1♂; Tatú, 1♂, 1♀. VENEZUELA: Río Cassiquiare, El Merey, 1♂; mouth of Río Ocamo, 1♀; Solano, 1♀; Caño Durutomoni, 1♂, 1♀; Mt. Duida, Esmeralda, 2♂; Río Orinoco, Munduapo, 1♂, 1♀.

***Thamnophilus aethiops kapouni* Seilern**

Thamnophilus aethiops kapouni SEILERN, 1913 (December), Verh. Orn. Ges. Bayern, XI (4), p. 277—Yahuarimayo, Carabaya, s. e. Perú; ♂; Mus. Seilern, Leskna, Czecho-Slovakia.

The number of specimens known of this subspecies is not great and the various examples come from some widely separated localities. Two females at hand from eastern Perú help to clear up the probable lines of connection between these various places but there are still wide gaps where no examples have been taken to date. One of the present females is from Orosa, Río Amazonas; the other is from the mouth of the Río Urubamba. Thus a connection is possible within the Tropical Zone from Huachipa, upper Huallaga, to the lower Marañón, up the Ucayali and its affluents to Chuchurras and the mouth of the Urubamba, and thence southeasterly across the low divide to the Madre de Dios Valley and the adjacent portions of Perú and northwestern Bolivia where the bird previously has been found.

The Orosa skin differs slightly from the specimen taken at the mouth of the Urubamba in that it is slightly darker both above and below, especially on top of the head, but the Urubamba skin is not fully adult. In any case, the differences are not greater than those shown by three females from Huachipa (in Field Museum of Natural History), and probably are purely individual. The Orosa specimen is distinctly darker than females of *juruanus* from the Río Purús (in the Carnegie Museum) and can not be referred to that form; besides Mr. Todd informs me that his series from São Paulo de Olivença, Brazil, considerably east of Orosa, is referable to *kapouni* which probably thus ranges eastward to the left bank of the Juruá.

Peruvian localities where the bird has been taken, not included in the list of specimens examined, are Yahuarmayo, San Gaban, and Chuchurras.

In studying the allied subspecies from various regions in Brazil, several points of interest have come to light. A male and female from Faro, across the Amazon from the recognized range of *punctuliger*, appear to be inseparable from that form and extend the range accordingly. They represent the first records of the species from Faro.

A large series of *polionotus* from the vicinity of Mt. Duida and the Cassiquiare in Venezuela help to bridge the gap between the records from the Río Caura and the upper Río Negro in Brazil whence that subspecies was described. Several examples from various localities on the right bank of the Río Negro carry the range of this form southeastward nearly to the mouth of that river at Igarapé Cacao Pereira.

A small series of skins from the left bank of the Río Madeira, across the Amazon from the mouth of the Río Negro are very like *polionotus*, but there are some differences associated with the geographical separation which warrant the recognition of a new subspecies from that restricted area. Hellmayr (Novit. Zool., XIV, p. 369, 1907; *op. cit.*, XVII, p. 339, 1910) noted a single male from Humaythá, in the same region, which he first identified with *polionotus* but later (Field Mus. Nat. Hist. Publ., Zool. Ser., XIII, pt. 3, p. 82, 1924) believed to be only an aberrant example of *punctuliger*, found on the right bank of the Madeira. However, the present series shows clearly that the birds from the left bank have quite constant characters although they are, like *polionotus*, in a sense intermediate between *punctuliger* and *juruanus*, as would be expected from the relative geographical positions of the respective ranges. The description of the new form follows.

***Thamnophilus aethiops injunctus*, new subspecies**

TYPE from Rosarinho (Lago Sampaio), Río Madeira (left bank), Brazil. No. 281,902, American Museum of Natural History. Adult male collected June 27, 1930, by the Olalla brothers.

DIAGNOSIS.—Nearest to *T. a. polionotus* from the upper Río Negro but slightly paler. Males with under parts paler gray, especially on the breast; lores clearer gray; back averaging lighter gray but black of head carried somewhat farther posteriorly, over the hind neck. Females duller, less rufescent above; breast and sides of head paler, less brownish; belly lighter, often ochraceous. Somewhat similar to *T. a. punctuliger* from the right bank of the Río Madeira, but lacks the white interscapular patch in both sexes, while the upper wing-coverts are still tipped with white in the male; both sexes darker than *punctuliger*.

Females apparently indistinguishable from those of *juruanus* but males somewhat paler and with more white spotting on the upper wing-coverts, and with the black of the head not so deep nor so clearly defined from the gray of the superciliary region.

RANGE.—Left bank of the Rio Madeira, Brazil (probably ranging westward to the right bank of the Purús).

DESCRIPTION OF TYPE.—Top of head black though forehead is somewhat tinged with dark gray on the webs; this black is carried posteriad over the hind neck. Black Blackish Slate without any concealed white; sides of head, including a broad superciliary stripe, light Slate Color, paling into Slate-Gray × Deep Neutral Gray on the throat and dark Slate-Gray on the breast and flanks; belly somewhat lighter with indications of whitish tips, not pronounced; thighs gray; under tail-coverts Deep Neutral Gray, with narrow whitish tips. Wings and tail blackish; remiges edged with the color of the back; upper wing-coverts (except primary series) and alula with a prominent, triangular, white spot at the tip of each feather, largest at the shoulder where they form a nearly solid white area; under wing-coverts grayish at base, white at tip; inner margins of quills pale but not sharply whitish; rectrices margined with the color of the back; outermost pair with a small, white, terminal spot. Bill black; feet slaty black. Wing, 76 mm.; tail, 53.5; exposed culmen, 16.25; culmen from base, 21; tarsus, 22.75.

REMARKS.—Females with top of head light Auburn × Sanford's Brown, carried to the hind neck and rather sharply defined from the light Argus Brown back. Lower back somewhat duller than mantle and upper tail-coverts. Sides of head Auburn × Amber Brown, passing into Amber Brown × Sudan Brown on the throat; breast about Amber Brown; belly and under tail-coverts paler, sometimes Ochraceous-Tawny × Cinnamon-Buff; flanks near the color of the breast; femoral areas darker and browner, Amber Brown × Argus Brown. Wings blackish, quills margined with the color of the back; upper wing-coverts tipped with the color of the back though with slight indications of a paler terminal speck; under wing-coverts bright Ochraceous-Tawny; tail light Chestnut-Brown, with inner webs or margins sootier and outer margins brighter; tips of outermost two or three pairs buffy. Bill blackish, a little paler than in the male; feet slaty black. Wings, 71.75–75 mm.; tail, 55.25–59; exposed culmen, 16–17; culmen from base, 21; tarsus, 20–22.5.

A male not fully adult has the remiges (except the longest tertials) and the primary-coverts duller and margined with olive brown instead of gray; the alula is olive brown, with buffy outer margins; the belly is paler gray, more whitish.

Adult males measure as follows: wing, 74–78.25 mm.; tail, 58.5–63; exposed culmen, 16–17; culmen from base, 21–22; tarsus, 22–23.5.

The series of birds from various parts of Brazil shows good intergradation between adjacent subspecies. For example, a male of *atriceps*

from Caxiricatuba, Rio Tapajoz, has the top of the head hardly blackish and resembles *incertus*, while some males of *incertus* from the Tocantins have suggestions of blackish on the crown. The amount of white on the back and upper wing-coverts in males of *punctuliger* is extremely variable and one female from Igarapé Brabo, Rio Tapajoz, has no white on the mantle, resembling *atriceps*. A female of *punctuliger* from Villa Bella Imperatriz similarly lacks the white on the back and otherwise resembles *injunctus*. Two males of *punctuliger* from Matto Grosso have the white on the back much reduced and probably approach *kapouni* in that respect. A male of *polionotus* from the foot of Mt. Duida, Venezuela, has a distinct white patch on the mantle as in *punctuliger*.

T. a. aethiops of eastern Ecuador is the most noticeably distinct form, but its characters decidedly are only ones of degree, and hence need not be considered as of more than subspecific value.

A series of three males and three females of *juruanus* from Hyutanahán, Rio Purús (left bank?), kindly loaned by Mr. Todd, is rather exactly intermediate between the new form, *injunctus*, and *kapouni*. The males are somewhat clearer gray than those of *kapouni* but are not so pale as those of *injunctus*, and the amount of white on the upper wing-coverts varies between the one extreme and the other. The male which has the white tips on all the upper wing-coverts also has an unusual amount of white elsewhere, including a well-developed white interscapular patch which is not found normally in either *juruanus* or *injunctus*; whitish tips on the belly and the longer upper tail-coverts and a single white feather in the left malar region indicate some irregularity in coloration in addition to an approach toward *injunctus*. The white tips on the rectrices also are less well-developed in *juruanus*. The females of *juruanus* from the Purús are not certainly distinguishable from those of *injunctus*, described in a previous paragraph. Topotypical females from the Juruá have yet to be described.

I must confess myself unable to include *occidentalis* in the *aethiops* group and am not even convinced that it belongs in *Thamnophilus*. The rounded, exposed nostrils are almost as conspicuous in dorsal aspect as they are in lateral view. Furthermore, the white patch on the shoulder is formed in a different manner, the white spots on the lesser upper wing-coverts remain of uniform size to near the radial margin of the wing, and on the broad margin the feathers are almost entirely white nearly to their bases, sometimes with a terminal or subterminal area gray with or without a small white tip as on the longer coverts. In the *aethiops* group, the white tips of the lesser coverts become progressively

larger near the radial margin, expanding on the outer web or both webs but leaving the bases of the feathers dusky. The resemblance between the two patterns is purely superficial.

The same style of coloration is found in *Dysithamnus punctitectus* and a careful comparison between that species and *occidentalis* shows resemblance also in the structure of the bill; under wing-coverts with some whitish shaft lines but not broad whitish tips. In short, *occidentalis* resembles *D. punctitectus* in all respects except for its darker gray coloration and should be considered as conspecific with it. Since *occidentalis* is the older name it becomes the specific term for both subspecies.

There is considerable resemblance to *D. plumbeus leucostictus* in both *occidentalis* and *punctitectus*, but *leucostictus* has been found in at least two localities where *punctitectus* occurs including the type locality of the last-named form. The female from this locality, Oyacachi, Ecuador, actually shows some approach toward female *punctitectus* in the darkening of its general coloration, but it is still indubitably a *leucostictus*. Conversely, the female topotype of *punctitectus* has suggestions of white shaft-streaks on the sides of the head and throat. However, much more must be known of both species before any further association should be attempted.

SPECIMENS EXAMINED

T. a. aethiops.—ECUADOR: Sarayacu, 1♂; below San José de Sumaco, 3♂, 2♀; Río Suno, above Avila, 1♂, 1♀; mouth of Río Curaray, 1♂, 1♀; "Ecuador," 1♂.

T. a. kapouni.—PERÚ: Orosa, 1♀; mouth of Río Urubamba, 1♀; Huachipa, 1♂¹, 3♀¹. BOLIVIA: Todos Santos, 1♂; Mission San Antonio, Río Chimoré, 1♂.

T. a. juruanus.—BRAZIL: Hyutanahan, Río Purús, 3♂², 3♀².

T. a. injunctus.—BRAZIL: Rosarinho, Río Madeira (left bank), 5♂ (incl. type), 4♀.

T. a. punctuliger.—BRAZIL: Villa Bella Imperatriz, Río Amazonas, 18♂, 6♀; Limcoal, Río Tapajoz (left bank), 2♂, 2♀; Igarapé Amorin, 2♂, 3♀; Igarapé Brabo, 4♂, 3♀; Faro, Río Jamundá, 1♂, 1♀; Morinha Lyra, Matto Grosso, 1♂; "Camp 9," Rio Roosevelt, 1♂.

T. a. atriceps.—BRAZIL: Caxiricatuba, Río Tapajoz (right bank), 5♂, 3♀; Aramanay, 1♀; Piquiatuba, 1♀.

T. a. incertus.—BRAZIL: Baião, Río Tocantins (right bank), 4♂, 1♀; Pedral, 2♂; Mocajuba, 1♂, 1♀; Utinga, near Pará, 2♂, 3♂¹, 2♀¹; Santa Isabel, 1♂, 1♀; Pará, 1♀; Tury-assú, Maranhão, 1♂¹.

T. a. polionotus.—BRAZIL: Igarapé Cacao Pereira, Río Negro, 2♂; Santa Maria, 1♀; Riqueza, 1♂; San Gabriel, 1♂; Tabocal, 2♂. VENEZUELA: (Río Cassiquiare and vicinity of Mt. Duida), 20♂, 16♀.

Dysithamnus o. occidentalis.—COLOMBIA: Cocal, 1♂ (type).

¹Specimens in Field Museum of Natural History, Chicago.

²Specimens in Carnegie Museum, Pittsburgh.

D. o. punctilectus.—ECUADOR: below Oyacachi, 2♂ (incl. type), 1 ♀; lower Sumaco, 1♂.

D. ardesiacus leucostictus.—ECUADOR: lower Sumaco, 7♂, 7 ♀; Guayaba, 1 ♀; below Oyacachi, 1 ♀; Sabanilla, 4♂, 3 ♀; Zamora, 1♂. COLOMBIA: Buena Vista, 1 ♀.

***Thamnophilus unicolor grandior* Hellmayr**

Thamnophilus unicolor longicaudus CHAPMAN (*nec* VIEILLOT), 1923, Amer. Mus. Novitates, 86, p. 1—Barro Blanco, Antioquia, Colombia; ♂; Amer. Mus. Nat. Hist.

Thamnophilus unicolor grandior HELLMAYR, 1924, Field Mus. Nat. Hist. Publ., Zool. Ser., XIII, pt. 3, p. 84—new name for *T. u. longicaudus* CHAPMAN.

Four males and one female from Chaupe, recorded by Chapman (Bull. Amer. Mus. Nat. Hist., LV, p. 381, 1926), are the first examples noted from Perú, to which may be added a fifth male now at hand from Uchco.

These birds and a male from Zamora Ecuador, compare well with a series from Colombia and are not clearly distinguishable, although the range in Ecuador and Perú does not connect well with that in Colombia. In the last-named country, *grandior* occupies all the slopes of the three Andean ranges except the eastern slope of the eastern Cordillera, while in Ecuador and Perú it apparently occupies only that slope and is replaced in western Ecuador by typical *unicolor*.

The single female from Perú is as strongly rufescent on the upper parts as the most rufous females from Colombia but below is not so rufous as these but more like the duller Colombian females. Thus, while its range of coloration is entirely within that of the Colombian series, the exact combination of dorsal and ventral hues can not be perfectly matched. However, since no two of the Colombian birds are exactly alike, this fact is not likely to be very significant though it is worthy of further study when more material becomes available.

Several males from both Colombia and Perú have suggestions of tiny white spots on the tips of some of the upper wing-coverts. Young males have the upper wing-coverts brown tipped with ochraceous.

***Thamnophilus unicolor caudatus* Carriker**

Thamnophilus unicolor caudatus CARRIKER, 1933 (March 24), Proc. Acad. Nat. Sci. Phila., LXXXV, p. 16—Río Jelashte, Perú; 5000 ft.; ♂; Acad. Nat. Sci. Philadelphia.

This form has been described recently and is unknown to me. As noted in the account of *grandior*, a male from Uchco (5000 ft.) is referable to that Colombian form. It shows no trace of the characters assigned to *caudatus*, having the wings entirely deep bluish gray above

and the measurements as in typical Colombian examples. This is all the more curious when the relative geographical positions of Uchco and the Río Jelashte are examined. Uchco is on a small affluent of the Río Mayo which empties into the lower Huallaga from the west, while the Río Jelashte is an affluent of the Huayabamba which likewise empties into the lower Huallaga from the west. There probably is a distance of about one hundred kilometers between Uchco and the unspecified point on the Río Jelashte at the same elevation as Uchco, where the skins of *caudatus* were obtained. That there is in rare instances a faunal distinction between the valleys of the Mayo and the Huayabamba is shown by my notes on the separation of *Tangara c. chilensis* and *T. c. chlorocorys* in the same region (Proc. Biol. Soc. Washington, XLII, p. 93, 1929). The range of *caudatus* must be very restricted unless it follows the upper Tropical Zone on the left side of the Huallaga toward the south where it has some little room for extension.

The characters of *caudatus* are suggested in immature *unicolor* and *grandior* where the tips of the greater upper wing-coverts are light in color, though tawny, not white.

SPECIMENS EXAMINED

T. u. unicolor.—ECUADOR: Zaruma, 2♂, 4♀; El Chiral, 3♂, 1♀; Salvias, 1♂; Coto, 1♂, 2♀; San Bartolo, 1♀; Las Piñas, 1♀; Mindo, 1♂.

T. u. grandior.—COLOMBIA: Barro Blanco, 2♂ (incl. type); Aguadita, 1♂; Gallera, 1♂, 1♀; San Antonio, 3♂, 1♀, 1♂¹, 1♀¹; La Palma, 1♂, 1♀; La Candela, 1♂, 1♀; Ricaurte, 1♂, 1♀; Cocal, 1 "♂" (= ♀); Cerro Munchique, 1♀; Fusugasugá, 1♀; Bogotá, 1♂¹. ECUADOR: Zamora, 1♂. PERÚ: Chaupe, 4♂, 1♀; Uchco, 1♂.

¹Specimens in Field Museum of Natural History, Chicago.

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STUDIES OF PERUVIAN BIRDS. X¹THE FORMICARIAN GENUS *THAMNOPHILUS*. PART II

BY JOHN T. ZIMMER

I am greatly indebted to Mr. W. E. C. Todd of the Carnegie Museum, Pittsburgh, and Dr. Janusz Domaniewski of the Polish Museum of Natural History, Warsaw, for the loan of specimens which have aided in the study of certain of the species treated in the present account.

***Thamnophilus schistaceus schistaceus* D'Orbigny**

Thamnophilus schistaceus D'ORBIGNY, 1836, 'Voy. Amér. Mérid.,' IV (3), Oiseaux, p. 170—Bolivian Andes, vicinity of Cochabamba = Yuracares, n. Bolivia; ♂; Paris Mus.

This species is not satisfactorily known at present. Two of its subspecies, *capitalis* and *heterogynus*, are quite distinct and usually easily recognizable. Intergradation of typical *s. schistaceus* with *s. capitalis* occurs in northern Perú over a wide belt, at the opposite ends of which there is a decided approach toward the adjacent forms, *capitalis* in the north and *schistaceus* in the southeast. This matter is discussed under *T. s. dubius*.

East of the range of *capitalis* on the south bank of the Amazon, *heterogynus* occurs. It was described from Teffé and, as shown by specimens before me, ranges eastward to the left bank of the Rio Madeira. It probably does not ascend very far up the Purús, Juruá, or Madeira rivers, for specimens from the upper portions of these streams have been identified with *schistaceus*; the females, at least, would not be liable to confusion in identification.

On the Rio Madeira, Hellmayr has recorded *schistaceus* from Humaythá and Marmellos, both on the left bank. The Marmellos birds, being males, might be extreme examples of *heterogynus* but two of the Humaythá skins are females which Hellmayr mentions as being quite distinct from *heterogynus*.

¹Earlier papers in the series comprise American Museum Novitates Nos. 500, 509, 523, 524, 538, 545, 558, 584, and 646.

It is evident, therefore, that *schistaceus* descends the left bank of the Madeira at least as far as Humaythá. On the right bank another complication is met. There are records of *schistaceus* down the whole course of the stream to Borba, and east to the left bank of the Tapajoz at Villa Braga and Boim, while from east of the Tapajoz another form, *T. s. inornatus*, has been described.

I have at hand no material from the region of the upper Madeira except a female from Barão Melgaço on the Gy-Paraná, which is typical neither of *schistaceus* nor of *inornatus*. From the neighborhood of Borba I have four males and six females; from the Amazon west of the Tapajoz, two males and three females; from the left bank of the Tapajoz, five males and four females; from the right bank of the Tapajoz, seven males and three females; left bank of the Xingú, one male, one female; right bank, three males, six females; right bank of the Tocantins, one male. There is some variation in this material and some inconsistency at Borba, but I am unable to draw any line through the series as definite as that which seems to separate the series as a whole from Bolivian birds. The males all have a certain amount of dusky shading on the centers of the coronal feathers, and although the skin with the heaviest black on the crown is from the right bank of the Tapajoz, others from the same region and from the Xingú have no more than some of the more western specimens. Some have the belly rather whitish, but others do not, and both extremes are found on both sides of the Tapajoz.

In general, however, the males are darker above than Bolivian males and reach a greater extreme of paleness below, while there are more frequent traces of whitish tips on the upper wing-coverts. The females are distinguished by a greater intensity of rufous coloration on the top of the head and a more deeply colored back, while the upper wing-coverts more frequently show bright tips and the sides of the head are brighter, more buffy and less grayish.

As to size, there is little that is conclusive. The males from east of the Tapajoz have the wings, 63-68 mm.; tail, 50-55; west of the Tapajoz, wings, 60-67.25 mm.; tail, 50-54; Bolivia, wings, 61-68.5 mm.; tail, 48-54. Females from east of the Tapajoz, wings, 64-66 mm.; tail, 53-55.5; west of the Tapajoz, wings, 63-68 mm.; tail, 54-56.5; Bolivia, wings, 61-67 mm.; tail, 50-54 (one specimen has wings, 58.5; tail, 46).

Two females from Borba do not fit well into the series, being distinctly grayer on the back than either *inornatus* or *schistaceus*, but the top of the head is bright and agrees much better with the color of *inornatus*. On the other hand, five females from Igarapé Auará, a very short

distance above Borba, are rather brighter above and below than typical *inornatus* and may indicate a slight trend toward *heterogynus* of the west bank of the Madeira.

The conclusion thus seems justified that *inornatus* ranges west to the right bank of the Madeira near its mouth and a short distance up the stream, merging into *schistaceus* somewhere on the way to Bolivia.

West of the upper Madeira, *schistaceus* extends to the upper Purús and upper Juruá, up the Mamoré and Beni into northern Bolivia and western Matto Grosso, Brazil, and up the Madre de Dios into south-eastern Perú. Two males and one female from Astillero and one male and two females from Río Tavara, Perú, are not separable from Bolivian birds and corroborate Hellmayr's records of *schistaceus* from Yahuar-mayo and Río San Gaban.

***Thamnophilus schistaceus dubius* (Berlepsch and Stolzmann)**

Dysithamnus dubius BERLEPSCH AND STOLZMANN, 1894, Ibis, p. 393—La Merced, Perú; ♂; Warsaw Mus.

Dysithamnus schistaceus hellmayri CORY, 1916 (August), Field Mus. Nat. Hist. Publ., Orn. Ser., I, p. 338—Rioja, n. Perú; ♂; Field Mus. Nat. Hist.

The central part of Perú is inhabited by birds so exactly intermediate between Bolivian *schistaceus* and Ecuadorian *capitalis* that the recognition of a distinct subspecies becomes of value only because of the extent of territory occupied by the intermediate individuals. Certain examples from the different parts of this range are very like one extreme or the other and the problem of delimiting the range thus becomes difficult though necessary because of the application of the different names which have been given at different points.

Berlepsch and Stolzmann described *dubius* from the Chanchamayo Valley on characters which appeared to exist in a male from La Merced. The bill was thought to be longer than in *schistaceus*, and much more compressed; the rectrices were less graduated and the lateral ones very little margined with white at the tips. All these characters, however, are variable ones which appear in birds from different regions. Hellmayr (Arch. Naturg., LXXXV, A (10), p. 94, 1920) discussed a male from Chanchamayo which was not separable from Bolivian examples of *schistaceus*, having only a slightly more slender bill but none of the other characters of *dubius*; there was no trace of dark centers on the feathers of the crown as in males from northern Perú (Yurimaguas, Chayavitas, Maynas, and Rioja).

These northern birds had been characterized by Hellmayr in 1907

(Novit. Zool., XIV, p. 62) and named *hellmayri* by Cory in 1916 (*loc. cit.*), being distinguished by the dark centers of the feathers on head and back. Hellmayr in 1907 noted a male from Chuchurras as nearly like the males of *heterogynus* which he described as darker than male *schistaceus*; in 1924 (Field Mus. Nat. Hist. Publ., Zool. Ser., XIII, pt. 3, p. 87) he assigned this bird to *hellmayri*. I collected two males of *hellmayri* at Puerto Bermúdez, not far from Chuchurras, which I discussed in 1930 (Field Mus. Nat. Hist. Publ., Zool. Ser., XVII, p. 322).

The present collection has in it birds from the upper Ucayali (Santa Rosa and Lagarto), the middle Marañón (Pomará), and from the Río Seco and Río Negro, west of Moyobamba, near Rioja (virtual topotypes of *hellmayri*); also a single female from Perené (a virtual topotype of *dubius*). It is impossible to divide this series satisfactorily. Most of the males are good intermediates between *schistaceus* and *capitalis*. The Pomará specimens are nearer *capitalis* and are darker than the average of the upper Ucayali birds which, in turn, are darker than Bolivian males of *schistaceus*. A male from the Río Seco, west of Moyobamba, which must represent *hellmayri* is nearer to typical *schistaceus* than any other male of the series, being relatively light gray above with no blackish centers on the feathers. Another Río Seco male, not quite adult, has some dusky centers, and a third male, also not quite adult, from a little farther west, on the Río Negro, has more extensive blackish centers, though they are much less marked than in the Pomará skins.

Three females from this same region, two from Río Seco and one from Río Negro, are very like the upper Ucayali females although two of them are rather worn and faded and might be thought too pale to match the others well. The third female (from Río Seco) is in fresh plumage though the tail is still in molt; it is slightly less warm brown on the back than the Chanchamayo female but matches some upper Ucayali skins well, while other upper Ucayali birds match the Chanchamayo bird equally well.

The upper Ucayali males are variable. Most of them have noticeable blackish subterminal areas on head and back but an occasional skin is not so marked. The white on the tip of the tail is of variable width but not entirely absent in any of the skins before me.

All these facts being considered, therefore, I believe that an intermediate form can be recognized ranging through the Tropical Zone of Perú from the Chanchamayo Valley, the upper Ucayali, and the middle Marañón Valley west of the Huallaga. This form must be called *dubius* which antedates *hellmayri*. It may be characterized by the darker gray

coloration of the males, with blackish centers to the feathers of the top of the head and back, though these features sometimes may be obsolete. The females are warmer brown on the back than those of *schistaceus* but not so deep as in *capitalis*, and the rufous color of the crown is similarly intermediate; the under parts are lighter than in *capitalis* but not so dull as in *schistaceus* though there is not always a definite distinction to be found in all examples.

Where this form crosses the Huallaga is not known at present. There is a specimen in the Vienna Museum collected by Poeppig in the "Province of Maynas" which Hellmayr (1907) refers to the form afterwards named *hellmayri*. It probably came from the left bank of the Huallaga, but the exact locality is not known. A Samiria skin is referred to *capitalis* which is in accordance with the occurrence of *capitalis* on the lower Ucayali, discussed below.

All the northern records thus possible to place definitely are from west of the Huallaga while on the left bank of the Ucayali, where the distance from the Huallaga is not great, *capitalis* is found, almost certainly extending across to the right bank of the Huallaga though not yet collected there. Similarly it is not known how far up the Ucayali *capitalis* extends. Consequently it is impossible now to state whether the portions of the range of *dubius* on the upper Ucayali and the lower Huallaga are connected or separated by a projection of the range of *capitalis*.

A female from Zamora, Ecuador, is more advanced toward *capitalis* than the Pomará skins, and might be considered as a slightly pale example of that form if it were not for a male from the same locality which has less black on the head and back than the Pomará males of *dubius*. Since both these birds are undoubtedly intermediate between *schistaceus* and *capitalis* they may be left in *dubius*, having been recorded by Chapman (Bull. Amer. Mus. Nat. Hist., LV, p. 383, 1926) under the name *hellmayri*.

Peruvian records are from Yurimaguas, Chayavitas, "Maynas," and the localities given in the subjoined list of specimens.

***Thamnophilus schistaceus capitalis* Sclater**

Thamnophilus capitalis SCLATER, 1858, P. Z. S., London, XXVI, pp. 65, 214—Río Napo, e. Ecuador; ♂; ♀; cotypes in British Mus.

This subspecies is well-marked in typical examples though it intergrades with *dubius* so pronouncedly that certain specimens are difficult to distinguish. Contrary to previous belief, this form crosses the Amazon

to the south bank and ascends the Ucayali at least on the left bank and as far as Sarayacu. Farther up the Ucayali occurs *T. s. dubius* though the point of separation has not yet been determined.

The Sarayacu birds are just as strongly marked as Río Napo skins. Among the males, one from Sarayacu, one from the upper Napo (below San José) in Ecuador, and two from Puerto Indiana at the mouth of the Napo in Perú show some grayish edges on the top of the head; the remainder have the crown and occiput purer black.

The eastward extension of the range of this form can not be fixed with precision from published records. North of the Amazon it has been found from Iquitos to Loretoyacu; south of the Amazon, only at Sarayacu and Samiria. On the Napo it ranges far upstream to Archidona, and, somewhere between this region and Zamora, intergrades with *dubius*.

SPECIMENS EXAMINED

T. s. inornatus.—BRAZIL: Rio Tocantins, Baião, 1 ♀; Rio Xingú (right bank), Tapará, 1 ♂, 4 ♀; Porto do Moz, 2 ♀; Villarinho do Monte, 1 ♂; Rio Xingú (left bank), Victoria, 1 ♂, 1 ♀; Rio Tapajoz (right bank), Aramanay, 4 ♂, 1 ♀; Caxiricatuba, 1 ♂, 2 ♀; Tauary, 2 ♂; Rio Tapajoz (left bank), Igarapé Brabo, 5 ♂, 4 ♀; Rio Amazonas (south bank), Villa Bella Imperatriz, 2 ♂, 3 ♀; Rio Madeira (right bank), Borba, 1 ♂, 2 ♀; Igarapé Auará, 3 ♂, 5 ♀.

T. s. schistaceus.—BRAZIL: Barão Melgaço, Matto Grosso, 1 ♀; Porto Velho, Rio Madeira, 1 ♀. BOLIVIA: Río Espíritu Santo, 2 ♂, 2 ♀, 2 ♂¹, 1 ♀¹; Todos Santos, 1 ♂, 3 ♀; Mission San Antonio, Río Chimoré, 7 ♂, 6 ♀. PERÚ: Astillero, 2 ♂, 1 ♀; Río Tavera, 1 ♂, 2 ♀.

T. s. dubius.—PERÚ: Perené, Chanchamayo, 1 ♀; Lagarto, upper Ucayali, 5 ♂, 5 ♀; Santa Rosa, upper Ucayali, 5 ♂, 1 ♀; Puerto Bermúdez, Río Pichis, 2 ♂¹; Moyobamba, 1 ♀¹; Río Seco, west of Moyobamba, 2 ♂, 2 ♀; Río Negro, west of Moyobamba, 1 ♂, 1 ♀; Rioja, 1 ♂¹ (type of *Dysithamnus schistaceus hellmayri* Cory); Pomará, Río Marañón, 5 ♂. ECUADOR: Zamora, 1 ♂, 1 ♀.

T. s. capitalis.—ECUADOR: Río Suno, above Avila, 2 ♂, 3 ♀; lower Río Suno, 3 ♂; below San José, 3 ♂, 2 ♀; mouth of Río Curaray, 3 ♂, 4 ♀; mouth of Lagarto Cocha, 2 ♂. COLOMBIA: Florencia, 1 ♂; La Morelia, 1 ♂, 2 ♀. PERÚ: Puerto Indiana, 4 ♂, 4 ♀; Anayacu, 1 ♀; Iquitos, 2 ♂¹; Sarayacu, Río Ucayali, 7 ♂, 2 ♀.

T. s. heterogynus.—BRAZIL: Rio Madeira (left bank), Rosarinho, 14 ♂, 11 ♀; Santo Antonio de Guajará, 4 ♂, 3 ♀.

Thamnophilus murinus canipennis Todd

Thamnophilus murinus canipennis Todd, 1927 (December 2), Proc. Biol. Soc. Wash., XL, p. 153—Tonantins, Rio Solimões, Brazil; ♂; Carnegie Mus.

A series of birds from eastern and northeastern Perú has been compared with topotypical examples of *canipennis* kindly loaned by Mr.

¹Specimens in Field Museum of Natural History, Chicago.

Todd. From this examination it appears that while the Peruvian birds are at one extreme of the limits of individual variation and topotypical examples at the other end, where they approach certain equally extreme examples of *murinus*, there is no good line where *canipennis* may be subdivided.

Thus, females from Tonantins are inclined to be dark on the upper parts, with the top of the head sometimes very rufous, the outer surface of the wings rufous brown, and the back moderately warm brown. Females from São Paulo de Olivença, on the south bank of the Amazon are similar, and a single female from Teffé the same, but of a darker hue. A female from Puerto Indiana, at the mouth of the Napo, is within the range of variation of these other birds.

An Orosa female, from the south bank of the Amazon below the mouth of the Ucayali is lighter above than most of these others, less warmly brown (with more of an olivaceous tone) on the back and wings, and paler on the crown, but it is like one Tonantins female in these respects though the latter is paler below (being like some of the dark-backed Tonantins birds in this particular). Of two females from Santa Rosa, upper Ucayali, one is a little more olivaceous on the back and wings, and the other a little less, than the Orosa bird, and the crown is correspondingly lighter in one and darker in the other.

The Peruvian males from all localities have the wings more purely gray than the males from Tonantins, São Paulo de Olivença, and the Rio Purús, all of which have a slight olivaceous tone. However, a Teffé male is hardly different from Peruvian males, perhaps a little paler, in which it is followed by three males from the left bank of the Rio Madeira two of which show a slight brownish suffusion on the wings. The Teffé male has only obsolete white tips on the upper wing-coverts, following the female in this respect, but the character is variable in Peruvian males as I have indicated. The Rio Madeira males have an unusual amount of white on the coverts. No females known from the Rio Madeira.

There may be some constant differences to be found in Rio Madeiran birds but without females I believe it inadvisable to attempt a segregation and refer the specimens to *canipennis* for the present.

Records from Perú not included in the specimens listed below are from Jeberos, Yurimaguas, Chamicuros, and Chuchurras.

In passing, it may be well to note that *T. m. cayennensis*, for a comparative series of which I am indebted to Mr. Todd, appears to range southward to the north bank of the Amazon at Faro, Brazil.

Faro specimens are not perfectly typical of this excellent form, but show some approach toward *murinus* of Manaos though they are distinctly closer to *cayennensis*. Incidentally, according to our series of *murinus*, the females of *cayennensis* are as readily distinguishable from those of *murinus* as are the males, though on somewhat different characters. Whereas the males of *cayennensis* have the wings brighter and more rufous, the females have both wings and tail lighter but slightly less rufous than in *murinus* females (Cinnamon Brown¹ x light Brussels Brown instead of Brussels Brown x Argus Brown); furthermore the belly is more broadly white and the sides of the head are distinctly grayer and less ochraceous.

T. m. murinus ranges up the Rio Negro on both banks and across to the upper Orinoco in Venezuela, thence across Venezuela eastward into British and Dutch Guiana. The British Guianan males tend to be slightly darker than the Rio Negro examples and the females also average darker and a little grayer above and below, but there are some specimens that are indistinguishable and those from the vicinity of the upper Orinoco range between both extremes. The British Guianan specimens, in certain respects, represent an approach toward *cayennensis* with the greater resemblance to *murinus*. I doubt that they are entitled to separation.

A specimen from the Río Uaupés, opposite Tahuapunto, extends the known range of *murinus* into Colombia.

SPECIMENS EXAMINED

T. m. cayennensis.—FRENCH GUIANA: Cayenne, 1 ♀; Tamanoir, 4 ♂², 3 ♀²; Pied Saut, 1 ♀². BRAZIL: Faro, 15 ♂, 4 ♀.

T. m. murinus.—BRAZIL: Rio Negro, Manaos, 3 ♂, 1 ♀; Igarapé Cacao Pereira, 1 ♂, 1 ♀; Santa Maria, 1 ♂, 2 ♀; Santa Isabel, 1 ♀; Yucabí, 1 ♀; Yavanari, 1 ♂, 1 ♀; San Gabriel, 3 ♂; Tabocal, 2 ♂; Tatú, 2 ♂, 5 ♀; Marabitanas, 2 ♂; Rio Uaupés (both banks), 5 ♂, 4 ♀. COLOMBIA: Río Uaupés, opposite Tahuapunto, Brazil, 1 ♂. VENEZUELA: (vicinity of Mt. Duida, up to 3000 feet) 48 ♂, 49 ♀; Suapure, 2 ♂, 2 ♀; La Unión, 3 ♂. BRITISH GUIANA: Potaro Landing, 7 ♂, 4 ♀; Tumatumari, 3 ♂, 1 ♀; Kamakusa, 3 ♂, 4 ♀; Merumé Mts., 1 ♂; Rockstone, Essequibo R., 1 ♂; Wismar, Demerara R., 1 ♂. DUTCH GUIANA: Paraku, Saramacca, 1 ♂; Lelydorp, 1 ♀.

T. m. caripennis.—BRAZIL: Tonantins, 1 ♂², 4 ♀²; São Paulo de Olivença, 1 ♂², 3 ♀²; Hyutanahan, Rio Purús, 1 ♂²; Teffé, 1 ♂, 1 ♀; Rio Madeira (left bank), Rosarinho, 2 ♂; Santo Antonio de Guajará, 1 ♂. PERÚ: Santa Rosa, upper Ucayali, 1 ♂, 2 ♀ (incl. type); Lagarto, 2 ♂; mouth of Río Urubamba, 1 ♂;

¹Names of color when capitalized indicate direct comparison with Ridgway's 'Color Standards and Color Nomenclature.'

²Specimens in Carnegie Museum, Pittsburgh.

Sarayacu, 1 ♂; Orosa, Río Amazonas, 2 ♂, 1 ♀; Puerto Indiana, 2 ♂, 1 ♀; Anayacu, 1 ♂. ECUADOR: mouth of Río Curaray, 1 ♂.

***Thamnophilus aroyae* (Hellmayr)**

Dysithamnus aroyae HELLMAYR, 1914 (February 27), XIV, p. 52—La Aroya (=La Oroya), Inambari Valley, 3000 ft., Marcapata District, se. Peru; ♂; Rothschild Collection, American Mus. Nat. Hist.

Thamnophilus aroyae, CARRIKER, 1932, Proc. Acad. Nat. Sci. Phil., LXXXIII, p. 464—descr. ♀.

A male from the Río Távara adds another locality to the records of this little-known bird, albeit the range is not materially altered thereby.

This specimen, like a Bolivian example already noted by Hellmayr and one of two males recorded by Carriker, has a white spot on the outer web of the outermost rectrix about one-third basad from the tip. This same mark is present on certain specimens of *T. nigrocinereus nigrocinereus* from the Rio Tocantins, Brazil, but not on others from the same locality, and is also on a specimen of *T. n. huberi* from Santarem. Both the Peruvian and the Bolivian males have a decidedly conspicuous, though not very large, silky white area concealed on the interscapulars, being found on the inner webs of various feathers where it is bounded anteriorly and posteriorly by a narrow and ill-defined blackish area, best marked in the Peruvian skin. This feature is not mentioned as existing in the type.

A female from the Yungas of Cochabamba, Bolivia, agrees fairly well with Carriker's description of topotypical females, but the back is more olivaceous than seal brown and has a small, concealed patch of white in the interscapular region; the greater and middle upper wing-coverts are finely tipped with white, preceded by an ill-defined sub-terminal mark of blackish; the tail has white on the tips of all the rectrices except the middle pair. Whether these characters would remain constant in a series has yet to be demonstrated.

The affinities of this bird are not clearly discernible, but the position between *murinus* and *punctatus*, where it has been placed by Hellmayr, seems best to fit the characters of the species.

SPECIMENS EXAMINED

T. aroyae.—PERÚ: Río Távara, 1 ♂. BOLIVIA: Yungas, Cochabamba, 3600 feet, 1 ♂, 1 ♀.

***Thamnophilus punctatus albiventris* Taczanowski**

Thamnophilus naevius-albiventris TACZANOWSKI, 1884, 'Ostr. Pér.,' II, p. 9—Guajango, Perú; ♂; Warsaw Mus.

Thamnophilus punctatus leucogaster HELLMAYR, 1924, Field Mus. Nat. Hist. Publ., Zool. Ser., XIII, pt. 3, p. 94—new name for *T. n. albiventris* Taczanowski.

This form is the most easily distinguishable of the various conspecies of *punctatus*. Its nearest affinity is not its geographically nearest neighbor, *atrinucha*, but rather the southern Matto Grosso form, *sticturus*, from which it is widely separated by nearly the whole of Perú and most of Bolivia. In fact, the line of association, as shown by present distribution, proceeds around the entire northern and northeastern portions of South America (with an apparent hiatus between the Cauca Valley and the Lake Maracaibo region of Venezuela or between the Cauca and the upper Río Meta of Colombia), and thence inland south-westward to Matto Grosso, leaving *albiventris* and *sticturus* at opposite ends of the long arc.

The bird from the upper Ucayali described by Stolzmann as *Thamnophilus punctatus sclateri* is *T. a. amazonicus*. A discussion of this misidentified form is given under *amazonicus* (pp. 10-14) where also the differences between *amazonicus* and *punctatus* are treated in detail.

Since *Thamnophilus naevius-albiventris* Taczanowski is not invalidated by the earlier *Thamnophilus albiventer* Spix [= *Taraba major stagurus* (Spix)] according to the recommendations of the 'International Rules of Zoological Nomenclature' (Article 36), I have restored Taczanowski's name. Fortunately, *albiventer* Spix is a synonym of a species which belongs in another genus, and there will be no cause for confusion in the similarity of names.

Peruvian records of *albiventris* are from Guajango, the type locality, and Perico, from which latter place additional specimens are now at hand. The records from the upper Ucayali refer to the birds which were afterwards named *sclateri* by Stolzmann as mentioned above.

The problem of attempting to establish the identity of *T. p. sclateri* has led to a study of various forms of *punctatus* not found in Perú. In the course of this study, several facts of interest have been disclosed which should be placed on record, though a number of points will require future examination of some additional material not now available.

In the first place, there is a form of *punctatus* living on the south bank of the Amazon between the right bank of the Xingú and the right bank of the Tocantins which is quite distinct from *T. p. saturatus* of both banks of the lower Tapajoz. The males are not strikingly different from those of *saturatus*, being decidedly more grayish below than males of *pelzelni*, but the back may average more extensively black, the forehead more broadly gray, the under parts and the sides of the head slightly paler gray, the outer edge of the outer margins of the inner remiges more often gray than blackish, and with a less strongly blackish band at the

basal margin of the white tips of the rectrices, though there is no sharp definition in these respects. On the other hand, the females are immediately distinguishable by having the tail in ventral aspect decidedly more rufous than blackish, with a distinct blackish line bordering the basal edge of the white tip, by less sooty upper wing-coverts, and by somewhat more grayish sides of the head. In general they resemble the females of typical *punctatus* except that the back is much brighter. The darker coloration of both sexes prevents confusion with *pelzelni* and *sticturus*.

On the middle stretches of the Rio Madeira no form of *punctatus* has been collected and recorded although the region has been explored. This leaves a hiatus between the range of *saturatus* on the lower Tapajoz and the region of the upper Madeira and its affluents, to which *saturatus* might have been expected to extend. If, as now seems to be the case, the northern Matto Grosso bird is to be associated with the Xingú and Tocantins examples, this hiatus represents an actual gap in the distribution of the species, though one form or the other may be found there at some future time.

In the light of these observations, the question of the identity of *T. stictocephalus* Pelzelin has again come to the front. The type of this form was supposed by Hellmayr (Field Mus. Nat. Hist. Publ., Zool. Ser., XIII, pt. 3, p. 96, footnote a, 1924) to be an individual variant of *T. p. sticturus* of southern Matto Grosso, southeastern Bolivia, and northern Paraguay, although it was noted as being decidedly darker gray beneath. More recently Dr. Hellmayr has written me that the type may well belong either to *saturatus* or to the form I described to him as occupying the Tocantins and Xingú rivers, but that the characters distinguishing these two forms could not be made out in this skin owing (in part, at least) to its poor condition. Since the males can not be distinguished in every case, the exact allocation of the type may depend more on the cumulative evidence of topotypes than on the type itself, and this determination must await further collections at the type locality, São Vicente.

Unfortunately, São Vicente is only a few miles north of Chapada, hardly farther away (though possibly in a different direction) than Abrilongo, which is the type locality of *pelzelni* to which the Chapada birds also belong. From Chapada, *pelzelni* ranges eastward along the plateau to the state of Goyaz before running northward, still on the tableland (except well to the north), to Maranhão. Both São Vicente and Chapada are on or near tributaries of the Guaporé in the Rio Madeiran

drainage though São Vicente, being nearer to the Amazonian forested region (if only by a few miles), is just that much more likely to have an Amazonian form endemic. That such a possibility exists is shown by the situation a few miles to the southward of Chapada where, on another affluent of the Guaporé, though in relatively close proximity to certain tributaries of the Rio Paraguay which flows southward, Engenho do Capitão Gama stands as the type locality for still another subspecies, *T. p. sticturus*, being the most northern locality for this form just as São Vicente must be, at this longitude, the most southern point of distribution for *stictocephalus*, with Chapada and its highland habitat at the western end of a finger-like projection of the range of *pelzelni* separating the other two.

The nearest relatives of the São Vicente bird, *stictocephalus*, may well be looked for, then, on the north, west, or east of this locality, since *pelzelni* occurs on the south. On the west no form of *punctatus* seems to occur. To the northward and northeastward lie the head-waters of various Amazonian streams such as the Xingú, Tapajoz, and certain affluents of the Madeira like the Rio Roosevelt. Two skins are at hand from a branch of the upper Tapajoz and the upper Roosevelt. Of these, a male from "Camp 2," Rio Roosevelt, is either *saturatus* or the Tocantins-Xingú form though not clearly assignable to either, being in imperfect condition. The other skin, a female from Utiarity, Rio Papagaio, is very definitely like the Tocantins and Xingú females in contrast to females of *saturatus*. The evidence at hand thus points rather clearly to the conclusion that these two birds are *stictocephalus* and that the range extends north and east across the upper waters of the Amazonian streams to the Xingú and Tapajoz and down these latter rivers to their mouths.

If later collections show that the Utiarity female just mentioned is not typical of the birds of this region and that the preponderating resemblance is rather to the birds of the lower Tapajoz, it may be necessary to place the name *saturatus* as a synonym of *stictocephalus* and name the Xingú-Tocantins form. On the other hand, more material from São Vicente may indicate some other procedure. In the light of material now at hand, it appears to be desirable to resurrect the name *stictocephalus* for the Xingú-Tocantins birds.

In western Bahia, *pelzelni* and the coastal form *ambiguus* intergrade and there are various specimens at hand which are not clearly assignable to either form together with others which, as a series, show a range of individual variation covering both extremes. I have referred these

examples to *pelzelni* pending Mrs. Naumburg's studies of the birds of that region.

The series of *punctatus* from north of the Amazon up to the Guianas and eastern Venezuela is rather variable but does not support the separation of a subspecies, *cinereinucha* Pelzel, as described from Manaos. Twelve males from the neighborhood of Manaos are not distinguishable from Cayenne skins. Thirteen females from the same region are darker and average somewhat duller than two Cayenne females though they are not as grayish in tone as four British Guiana specimens. Five females from Faro are more like the Cayenne than the British Guiana birds, being brighter than Manaos examples. A single female from the Rio Jarý is again like the British Guiana series and six females from eastern Venezuela show the same resemblance.

SPECIMENS EXAMINED

T. d. punctatus.—FRENCH GUIANA: Cayenne, 2 ♂, 2 ♀; Mana, 1 ♂. BRITISH GUIANA: Demerara River, 2 ♂, 1 ♀; Essequibo River, 1 ♂; Wismar, 3 ♀. DUTCH GUIANA: Paramaribo, 1 ♂. VENEZUELA: Paulo, Mt. Roraima, 2 ♂, 2 ♀; Arabupu, 2 ♂, 2 ♀; Cristóbal Colón, Paria Peninsula, 7 ♂, 4 ♀; La Cascabel, Río San Feliz, 2 ♂; Maripa, Caura, 2 ♀. BRAZIL: Rio Negro, Campos Salles, Manaos, 4 ♂, 7 ♀; Hacienda Rio Negro, 5 ♂, 3 ♀; Igarapé Cacao Pereira, 3 ♂, 3 ♀; Obidos, 1 ♂; Faro, Rio Jamundá, 11 ♂, 5 ♀; Santo Antonio da Cachoeira, Rio Jarý, 1 ♀.

T. p. saturatus.—BRAZIL: Rio Tapajoz (left bank), Igarapé Brabo, 5 ♂, 3 ♀; Igarapé Amorin, 1 ♀; (right bank), Aramanay, 4 ♂, 8 ♀; Santarem, 7 ♂, 2 ♀.

T. p. stictocephalus.—BRAZIL: Rio Roosevelt, 1 ♂; Rio Papagaio, Utiariti, 1 ♀; Rio Xingú (right bank), Porto do Moz, 4 ♂; Villarinho do Monte, 4 ♂, 1 ♀; Tapará, 2 ♀; Rio Tocantins (left bank), Cametá, 1 ♂, 1 ♀; (left bank), Mocajuba, 2 ♂; Baião, 3 ♂, 4 ♀.

*T. p. pelzelni*¹.—BRAZIL: Matto Grosso, Abrilongo, 1 ♂ (type); Chapada, 13 ♂, 15 ♀; São Paulo, Itapura, 1 ♂, 1 ♀; Bahia, Bôa Nova, 4 ♀; Sincorá, 2 ♂, 1 ♀, Tamburý, 1 ♂; Jaquaquará, 3 ♂; Orobo (?=Urubú), 1 ♂; Itirussú, 1 ♂; Iracema, 1 ♂; Morro de Chapeu, 2 ♂, 1 ♀; Santa Ritta, 7 ♂, 4 ♀; Piauhý, Corrente, 2 ♂, 1 ♀, 1 ♀?; Parnagua, 1 ♂, Gilbues, 1 ♂, 1 ♀; Santa Maria, Urusuhý, 1 ♀?; Therezina, 1 ♂, 2 ♀; Floriano, 1 ♂, 1 ♀; Ceará, Viçosa, 2 ♂; São Pedro de Cerity, 1 ♂, 1 ♀; Maranhão, As Mangueiras, 5 ♂, 4 ♀.

T. p. ambiguus.—BRAZIL: (no other locality), 2 ♂, 2 ♀ (cotypes of *nigricans* Wied); Bahia, 12 ♂, 9 ♀; Verruga, Rio Pardo, 1 ♂, 1 ♀; Rio de Janeiro, 1 ♂; La Raiz, foot of Organ Mts., 1 ♀.

T. p. sticturus.—BRAZIL: Belvedere do Urucum, Matto Grosso, 2 ♂; Urucum near Corumbá, 5 ♂, 4 ♀. BOLIVIA: Vermejo, Prov. Santa Cruz, 2 ♂, 1 ♀.

T. p. interpositus.—COLOMBIA: Barrigon, Río Meta, 1 ♂, 1 ♀; "Bogotá," 1 ♂, 1 ♀.

T. p. subcinereus.—COLOMBIA: (Santa Marta district), 7 ♂, 5 ♀; "Bogotá," 1 ♂, 1 ♀.

¹Some of these birds may belong to *ambiguus*.

T. p. atrinucha.—COSTA RICA: 1 ♂, 1 ♀. NICARAGUA: 1 ♂. PANAMÁ: 23 ♂, 14 ♀. COLOMBIA: (west coast and Cauca Valley) 18 ♂, 21 ♀. ECUADOR: (western regions), 18 ♂, 11 ♀.

T. p. albiventris.—PERÚ: Saucos, Río Chamaya, 2 ♂, 1 ♀; Cabico, Río Chamaya, 1 ♂; Perico, 3 ♂, 4 ♀; Jaen, 2 ♂; San Ignacio, 2 ♂, 1 ♀; Huarandosa, 2 ♂, 1 ♀.

***Thamnophilus amazonicus amazonicus* Sclater**

Thamnophilus amazonicus SCLATER, 1858, P. Z. S. London, XXVI, p. 214, Pl. cxxxix, figs. 1, 2—Upper Amazons (Bates)—Río Javari; ♂, ♀; cotypes in British Mus.

Thamnophilus punctatus sclateri STOLZMANN, 1926 (December 31), Ann. Zool. Mus. Polon. Hist. Nat., V (4), p. 215—upper Ucayali; ♂; Warsaw Mus.

A male from Santa Rosa, upper Ucayali, and a female from Sarayacu rather certainly represent typical *amazonicus*, described from the Javari a little east of the Ucayali. Two males and two females from Anayacu on the north bank of the Amazon belong to the same form. The males show some variation in the amount of black on the upper surface. Both extremes are from Anayacu and the Santa Rosa bird is intermediate. The paler Anayacu bird is very like certain males of *T. a. cinereiceps* from the upper Rio Negro, Brazil. The females are more uniform, though one Anayacu bird is darker above than the others and the Sarayacu skin has the belly slightly deeper in color, more like the breast, whereas in the two Anayacu skins there is a slight differentiation between the breast and the paler belly. This character also suggests *T. a. cinereiceps*.

There has been strong presumptive evidence that Stolzmann (*loc. cit.*) redescribed *amazonicus* as *Thamnophilus punctatus sclateri*. So far as available collections show, no form of *punctatus* occurs on the Ucayali nor, in fact, between the Rio Madeira and the upper Marañón, while *amazonicus* does occupy this exact region. The diagnostic characters given for *sclateri* are quite applicable to *amazonicus* which apparently was not considered by Stolzmann. Unfortunately, the exact differences between the forms of *punctatus* and those of *amazonicus* have never been properly understood and the superficial resemblances are so striking and numerous as to cause a great deal of confusion though the females are instantly distinguishable.

Partially with a view to aid in the correct assignment of *sclateri* and partially to distinguish between the males of *punctatus* and *amazonicus* subspecies where they occur together from the Guianas to the Amazonian region east of the Rio Madeira, I have studied a long series of

males of the different forms of both species where they do not occur together, in order to discover some differentiating characters of relative constancy. Two such characters have come to light with two more which are useful when taken in conjunction with the others. These characters are all slight ones which appear, at first glance, too small to be of service, but with them I have had no difficulty in assigning any of the several hundred males of the two species that I have examined and I am convinced that they are really diagnostic, in spite of their almost microscopic nature. To a certain extent they are discernible also in the females, which adds to their validity. The characters are as follows. In males of *amazonicus* and its conspecies, the feathers of the superciliary region, especially above the auriculars, have distinctly blackish bases, rather sharply defined from the gray tips; in *punctatus* and its allies, the bases of these feathers are gray, possibly duller than the tips but not distinctly blackish. There is sometimes a subterminal blackish area on these feathers which in most subspecies of *punctatus* never reaches a development great enough to cause any confusion, but in *T. p. atrinucha* of northwestern Colombia it is frequently very strongly developed, occasionally reaching the bases of the feathers. In such extreme cases the feathers in question are usually more than basally black, being almost entirely black with a terminal gray margin. In any event, since the range of *atrinucha* does not conflict with that of any form of *amazonicus*, there is little danger of confusion.

In *amazonicus*, the under primary-coverts may be pure white but, if marked with dusky, such markings are central, either as a shaft line or a lunule crossing the shaft, or, if the feather is largely dark, both margins are whitish; in *punctatus* these coverts are less frequently without dark markings and where these occur they are on the inner margins of the feathers, sometimes occupying the entire inner web, rarely crossing the shaft to the outer web and rarely appearing only on the outer and inner margins, leaving the central area entirely pale.

In *amazonicus* the dark bases of the under tail-coverts are inclined to be less sharply defined from the median area which is relatively darker than in *punctatus*, and the whitish tips, in turn, are not so sharply defined since the subterminal dusky line or spot is relatively duller; in *punctatus* the reverse is the rule, but there is much variation.

In *amazonicus* the gray of the under parts is darker; in *punctatus* lighter. Extremes are rather easily distinguished but the line of demarcation is not as wide as the band of individual variation in the same subspecies.

With these differences as the only tangible clues to distinguish the males of the two species it would not be surprising if a single male specimen, such as the type of "*sclateri*," were referred to the wrong species. The only characters given by Stolzmann are the black dorsum and longer white tips on the rectrices as compared with *T. p. punctatus*, and the black dorsum and the dark under parts as compared with *T. p. ambiguus*. The black dorsum is a variable character though of more frequent and more extended development in the *amazonicus* group, while the darker under parts are also characteristic of *amazonicus*. The white tips on the rectrices are also of somewhat greater extent in *amazonicus* than in *punctatus*, as described for *sclateri*. The description of "*sclateri*" thus is a good diagnosis of *T. a. amazonicus* to the extent of the given characters.

Furthermore, the type has remained unique and the type locality is in the range of *amazonicus* but far removed from that of any other form of *punctatus*. Without any examination of the type, it would be a logical conclusion that an error had been made in placing the bird in *punctatus*.

Through the kindness of Dr. Janusz Domaniewski of the Polish Museum of Natural History, I have been enabled to examine the type of "*sclateri*," which substantiates the conclusions reached by the above analysis. It is an unquestioned *amazonicus*, agreeing with the American Museum series from the Ucayali and showing all the details which distinguish males of *amazonicus* from those of *punctatus*.

The type gives evidence of being the specimen recorded by Sclater and Salvin in 1866 (P. Z. S. London, p. 185) as *T. naevius* and later assigned by Taczanowski to *albiventris*.

Peruvian records other than those in the subjoined list of specimens are from Chamicuros and Loretoyacu. A series of over thirty specimens is at hand from the right bank of the Rio Madeira, the Gy-Paraná, western Matto Grosso, and the "Yungas" of Bolivia (18° S. = near Cochabamba). These birds are not certainly distinguishable from the Peruvian skins of *amazonicus*. Perhaps the average extent of black on the upper surface of the males is greater, but without an equal number of males from the neighborhood of the Javari, the value of this distinction can not be determined. The females are equally close. An occasional specimen, as in the Peruvian series, shows an observable, though not sharp, distinction between the tones of coloration on the breast and belly, suggesting *T. a. cinereiceps*.

Of three skins from Villa Bella Imperatriz, between the Madeira

and the Tapajoz, the two males appear to be inseparable from Rio Madeiran skins. The single female is anomalous, being as pale in general color as *paraensis* females though without the rufous base of the tail which characterizes that form. Still farther east, on the right bank of the Tapajoz, the birds appear to be different, not in the direction of *paraensis* but the opposite. They deserve distinction and may be recognized as follows.

***Thamnophilus amazonicus obscurus*, new subspecies**

TYPE from Tauary, Rio Tapajoz (right bank), Brazil. No. 286,386, American Museum of Natural History. Adult female collected April 9, 1931, by A. M. Olalla.

DIAGNOSIS.—Nearest to *T. a. amazonicus* but somewhat larger; darker on the upper surface with more subterminal black on the mantle (difference especially noticeable on sides of back); males sometimes with back and top of head almost entirely black; females with head above darker rufous than in *amazonicus*, and tips of mantle-feathers darker and duller brown; median rectrices of both sexes usually without pale tips.

RANGE.—South bank of the Rio Amazonas in Brazil, between the Rio Tapajoz and the Rio Xingú; possibly east to the left bank of the lower Tocantins.

DESCRIPTION OF TYPE.—Top of head dark Sanford's Brown, with this color extending over the hind neck; back tipped with Brussels Brown x Raw Umber, with broad, black subterminal areas and a large concealed patch of silky white basad of the black; rump dark Brownish Olive; upper tail-coverts Mars Brown. Sides of head, including a narrow superciliary line, brighter than the crown, Sanford's Brown x Burnt Sienna; lores a little paler; chin, throat and breast Xanthine Orange x Amber Brown, belly lighter; flanks darker and duller; under tail-coverts like the breast. Wings blackish; primaries and secondaries margined exteriorly (except at base and tip) with light Antique Brown and with a broader white spot on the outer margins of secondaries near the tips; tertials with outer margins broadly and sharply white; greater and median upper wing-coverts black with broadly white tips largely confined to the outer webs; longer lesser coverts with pale tips sometimes whitish; rest of lesser coverts tipped with the color of the mantle; inner scapulars like the mantle, outer ones like the tertials; primary-coverts black; alula black with narrow white outer margin; under wing-coverts deep Orange-Buff; inner margins of remiges (except at tip and except on outer primary) Light Buff. Tail black with faint traces of Mars Brown at very base of outer webs; tips of all but middle rectrices white increasing in extent laterad; outermost rectrices also with a white spot on outer web two-fifths of the way from tip to base, reaching shaft. Maxilla blackish; mandible a little paler; feet dull slaty. Wing, 74 mm.; tail, 62; exposed culmen, 15; culmen from base, 19; tarsus, 21.

REMARKS.—Males with top of head black except at tips of forehead feathers which are gray (sometimes only laterally); mantle medially tipped broadly with black, laterally with dark gray (sometimes very narrowly and inconspicuously); an extensive patch of silky white concealed on median portion of feathers; rump tipped with black or sooty

gray; upper tail-coverts largely black with white tips. Lores and superciliary stripe dark gray, the superciliary stripe with well-defined black bases; the auriculars sooty; chin, throat, malar region, breast, and sides light Slate-Gray; belly somewhat lighter gray with traces of whitish tips; anterior under tail-coverts light Slate-Gray with varyingly distinct cross-bands of darker gray or blackish, and with somewhat whitish tips; longer coverts darker gray with cross-bands more blackish and pale tips more strongly whitish; bases of under tail-coverts sooty, not very sharply defined. Tail black with white markings as in the female. Wings blackish with pale markings on remiges and upper coverts disposed as in the female but all white; under wing-coverts white with a greater or lesser amount of gray or brownish gray markings disposed as shaft-lines or shaft-spots (not marginal as in *T. punctatus* and allies); inner margins of remiges white except at tips and except on outermost primary. Wings, 75-77 mm.; tail, 66-68; exposed culmen, 14.5-16; culmen from base, 19-21; tarsus, 20-23.

An adult male from the right bank of the Xingú agrees with the Tapajoz males. A female from the same region approaches *T. a. paraensis* in having a stronger indication of rufous on the basal portion of the middle rectrices, but it is not so developed as in *paraensis* and the general coloration is as in *obscurus* except that the concealed white on the mantle is reduced in extent and the subterminal black modified to sooty brown. A female from the Tapajoz shows a tendency in this direction, not so strongly developed. Young females from the Tapajoz agree well with the normal adults though the colors are a little duller.

One male from Tauary is so dark that the whole sides of the head are more blackish than otherwise and there are strong blackish subterminal areas on the breast feathers which form an obscured blackish band connected with the black of the sides of the neck. Above, the lateral interscapulars are only narrowly tipped with gray and the rest of the back and top of the head are entirely black.

One male from the type locality which is practically adult (though there are traces of brown on some of the scapulars) has narrow, gray tips on the median interscapulars and broader tips laterally, but there are heavy black subterminal areas here also; the ventral coloration is paler than in the other Tapajoz birds. Another immature male, from the Xingú, similarly has more gray above than the adult male from the Xingú; the character may thus be of little value in birds that are not fully adult.

A male from Faro, Rio Jamundá, on the north bank of the Amazon,

is small (wing, 69 mm.; tail, 60.5), in agreement with *paraensis*, and probably should be referred to that form; also a male from Kamakusa, British Guiana which, however, is more broadly grayish above than the southern specimens. In the original description of *paraensis*, Todd provisionally refers Guianan examples to this form and I am unable to add anything to his observations in the absence of a quantity of material. The Faro skin marks the only Brazilian record of *paraensis* from the north bank of the Amazon though it is not unexpected in view of the apparent occurrence of this subspecies in the Guianas.

It is interesting to note that in the Olalla collections from the neighborhood of the Tapajoz, the representative forms of *punctatus* and *amazonicus* were not secured at the same localities, though they were so secured on the Tocantins and the Jamundá. Heinrich Sneathlage has distinguished the common ecological associations of the two species in eastern Brazil and it is probable that they occupy different niches where they occur near to each other.

I have no hesitation in assigning to *Thamnophilus cinereiceps* a place among the conspecifics of *amazonicus*. A long series of *cinereiceps* shows much individual variation. Some of the males have considerable black on the head and back, exceeding that of some typical *amazonicus*. The breadth of white on the upper tail-coverts is variable as is the tone of gray beneath. Similarly, the females do not always have so much contrast between the colors of the breast and belly and sometimes there is no more such distinction than there is in extreme examples of female *amazonicus*. The upper tail-coverts are usually sooty with white tips but sometimes they are warm brown with white tips while fine ochraceous tips are present at the ends of these feathers in an occasional *amazonicus*. The characters that separate males of *amazonicus* subspecies from *punctatus* subspecies are equally noted in *cinereiceps* males and the measurements overlap. The only apparent conflict in range is based on certain specimens of *cinereiceps* supposedly from French Guiana but which Hellmayr (Field Mus. Nat. Hist., Zool. Ser., XIII, pt. 3, p. 98, footnote a, 1924) has effectively discounted as being dealers' skins without original labels, and therefore of doubtful geographic origin. *T. a. cinereiceps* ranges from Atures, upper Río Orinoco, Venezuela, south to the Rio Negro, Brazil, and along this stream southeastward at least as far as Santa Isabel on the left bank and Muirapinima on the right bank (which is not far above the mouth of the Negro on the west). This form undoubtedly occurs in Colombia near the Uaupés though there is no specimen actually from within the political boundary. Hellmayr mentions a

skin from 'Bogotá' collections which is referable to *amazonicus*, though I suggest a possibility it may prove to be a dark example of *cinereiceps*.

SPECIMENS EXAMINED

T. a. amazonicus.—PERÚ: Santa Rosa, upper Ucayali, 1 ♂; "Upper Ucayale," 1 ♂¹ (type of *Thamnophilus punctatus sclateri*); Sarayacu, 1 ♀; Anayacu, 2 ♂, 2 ♀. BOLIVIA: Yungas (18° S.), 1 ♀. BRAZIL: Tapirapoan, Matto Grosso, 1 ♀; Engenho do Gama, 1 ♀; Barão Melgaço, 1 ♀; Rio Madeira, Porto Velho, 1 ♂, 1 ♀; Borba, 13 ♂, 9 ♀; Igarapé Auará, 1 ♂, 2 ♀; Rio Amazonas, Villa Bella Imperatriz, 2 ♂, 1 ♀.

T. a. obscurus.—BRAZIL: Rio Tapajoz (right bank), Tauary, 5 ♂, 7 ♀ (incl. type); Rio Xingú (right bank), Porto do Moz, 2 ♂, 1 ♀.

T. a. paraensis.—BRAZIL: Utinga, 1 ♀; Apehú, 1 ♂; Santa Isabel (east of Pará), 1 ♀; Rio Tocantins, Mocajuba, 2 ♂, 2 ♀; Baião, 1 ♂, 1 ♀; Kelsú (Rosario), Maranhão, 1 ♂; Rio Jamundá, Faro, 1 ♂. BRITISH GUIANA: Kamakusa, 1 ♂.

T. a. cinereiceps.—BRAZIL: Rio Negro, Muirapinima, 7 ♂, 3 ♀; Yavanari, 2 ♂, 2 ♀; Santa Isabel, 1 ♀; Santa Maria, 5 ♂, 2 ♀; Uacará, 1 ♂; Mte. Curycuryari, 4 ♂, 1 ♀; Rio Uaupés (left bank), Tahuapunto, 2 ♂. VENEZUELA (Río Cassiquiare, upper Río Orinoco, and foot of Mt. Duida up to 700 ft., numerous localities), 93 ♂, 73 ♀; Maipures, Río Orinoco, 1 ♀.

Thamnophilus caerulescens melanchrous Sclater and Salvin

Thamnophilus melanchrous SCLATER AND SALVIN, 1876, P. Z. S. London, pp. 16, 18, Pl. III (♂)—Huio, Urubamba Valley, Perú; cotype in British Mus.

Thamnophilus luctuosus TSCHUDI (nec. LICHTENSTEIN), 1844, Arch. Naturg., X (1), p. 278—Perú.

Thamnophilus subandinus-major TACZANOWSKI, 1884, 'Orn. Pér.,' II, p. 7—new name for *Thamnophilus luctuosus* TSCHUDI.

A series of thirty-six specimens from central and southeastern Perú permits an accurate study of the characteristics of typical *melanchrous*, heretofore known from relatively few examples found in various collections.

There are also at hand eight skins from near Chachapoyas representing Taczanowski's *Thamnophilus subandinus*. The variation in true *melanchrous* is considerable but there are some points of average difference which may serve to distinguish the two forms, not all of which have been recognized by authors since Taczanowski first called attention to them in 1882 (P. Z. S. London, p. 29). Thus the males of *melanchrous*, with few exceptions, have the tips of the shorter lesser upper wing-coverts (along the radial margin of the wing) so broadly white that the black bases are nearly or entirely concealed, making a solidly white patch which is followed by three rows of white spots across the wing on

¹Specimen in Polish Museum of Natural History, Warsaw.

the tips of the longer of the lesser coverts, the median series, and the greater coverts. In *subandinus* the tips of all the upper wing-coverts are white but those of the smaller of the lesser series are narrow like those of the remainder, making the radial margin spotted with white but not solidly white. Several Junín males are like *subandinus* in this respect but by far the larger number can be recognized without difficulty.

The amount of white on the tips of the rectrices is the same in both series. The marginal spot on the outer web of the outer rectrix is sometimes absent in *melanchrous* but sometimes supplemented by a second smaller white marginal marking. This second marking is indicated also in three of the four males of *subandinus* now before me, and also in other males from Chinchao which I refer to the same form. The under wing-coverts are pure white in some Urubamba Valley males, but in others their dusky bases are visible especially toward the metacarpal margin. The birds from southeastern Perú, the Junín region, Chinchao, and northern Perú have this blackish admixture present in varying degree.

The flanks and belly in no case are pure black, having in every example some trace of white, however faint, along the shafts or at the tips of some of the feathers. Young birds and even some adults have a tendency toward grayness in this region with a suggestion of the black and white barring which is characteristic of the Bolivian *aspersiventer*. The extreme of resemblance to *aspersiventer* in this respect is found in the immature males of *subandinus*. One of these from La Lejia, north of Chachapoyas, is as strongly marked on belly and flanks as any Bolivian male, but the under tail-coverts have markings less distinct, being more extensive than the plain white tips of *subandinus* and *melanchrous* adults and less than the full bars of *aspersiventer*.

One adult male of *subandinus* from San Pedro, south of Chachapoyas, has some portion of the outer margins of all the primaries and of nearly all the secondaries white. This is more than is present in any skin of *melanchrous* and is in accord with Taczanowski's description of *subandinus* but, unfortunately, it is not corroborated by the other northern specimens.

The females are far from uniform. Depending somewhat upon age, the breast has a varying amount of buffy suffusion, but it is never clear gray. Similarly the degree of blending between the colors of breast and upper belly is variable and both extremes are found in Urubamba and Junín birds as well as in *subandinus*. The single Santo Domingo female shows a sharper division than any of the others. The back is variably

tinged with olive (the young females may be quite olivaceous brown), possibly more distinctly grayish in *subandinus*. The subterminal parts of the feathers of the lower mantle are varyingly blackish, apparently more extensively so in *subandinus* and sometimes only indistinctly sooty in some true *melanchrous*. Two females of *melanchrous* from Torontoy and San Miguel Bridge, Urubamba Valley, have both black and white concealed in small amount on the mantle as in *aspersiventer*. Both also have pale spots on the upper wing-coverts. The Torontoy female, which is not fully adult, has buffy spots at the tips of the greater coverts which otherwise are somewhat brownish. The female from San Miguel Bridge has the upper wing-coverts blackish with a few pure white dots at the tips of some of the median coverts. Three other females, from San Miguel, Chelpes, and Santo Domingo, have similar white or whitish dots on some of the coverts.

One of the females of *subandinus* from San Pedro has similar small white dots on the coverts but one from La Lejia has more distinct ones on the greater and middle coverts and the alula, and even on the outer scapulars, and suggestions of the same on the lesser coverts. The second female from La Lejia is not fully adult and has the markings even stronger than in the adult from the same locality, though less clearly white. A young bird without sex, apparently a female, from San Pedro, has buffy tips only on the greater coverts and alula. A female from Chinchao, in Field Museum of Natural History, has no markings on the coverts. Carriker records white markings on one of three females from Leimebamba. Possibly there is thus a greater tendency toward such marking in *subandinus* than in typical *melanchrous*.

The outer rectrices are always tipped with white in both *melanchrous* and *subandinus*. Usually the second pair also are so tipped and sometimes the third in adults, while young birds may have this marking carried even farther toward the middle rectrices. The young female of *subandinus* from La Lejia has even a very faint trace of it on the middle pair. A whitish marginal spot on the outer web of the outer rectrices about one-third of the distance back from the tip (similar to the white spot found in this position in most males) is present in the young female of *subandinus* from La Lejia and in the female of *melanchrous* from Santo Domingo. In the latter bird it is probably a sign of approximation toward *aspersiventer* of Bolivia where it is of common occurrence.

The black of the crown is carried a little more strongly over the hind neck in *subandinus* than in *melanchrous*. The wing-lining and belly are a little paler buff; the flanks and under tail-coverts are more decidedly

lighter in color, being Buckthorn Brown (x Raw Sienna) whereas in *melanchrous* they are Ochraceous-Tawny x Sudan Brown, or even more rufescent, approaching bright Amber Brown. This last character appears to be the most useful one for the separation of the females of the two series, though there is no sharp division. One female from Torontoy, Urubamba Valley, has the belly paler than any of the *subandinus* females and, while the crissum is a trifle deeper in color than it is in the *subandinus* examples, the specimen is less distinct from them than from the darker specimens of *melanchrous*.

It will be seen that in various respects, *subandinus* resembles *aspersiventer* (while in other particulars it is farther removed than is *melanchrous*). Thus the tendencies toward more extensive white on wings and tail and more extended black on the hind neck of the females are of this nature. The paler ventral areas and the grayer backs with more pronounced subterminal black on the mantle are in the opposite direction. The resemblances possibly may be of a relict nature, retained by a peripheral form farthest removed from the ancestral home where these particular characters were originally developed. The strong banding of young males of *subandinus* should be considered here also.

A word may be necessary regarding the specific name used for the present birds. There can be no question that *subandinus*, *melanchrous*, and *aspersiventer* are conspecific (I am unable to recognize *steinbachi* from the Cochabamba region). Typical males of *caerulescens* are gray on the back, with the black restricted to a central patch more or less concealed; in *paraguayensis* the dorsal black may be more extended and in *connectens* also. An occasional skin of *aspersiventer* and *melanchrous* has the uropygium sooty grayish instead of black, somewhat bridging this difference between *aspersiventer* and *connectens*. On the under side, *caerulescens* sometimes shows traces of cross-bars on belly and crissum marked in gray instead of black. Furthermore, *connectens* may have the breast-feathers distinctly blackish subterminally. A young male *aspersiventer* from Pitiguaya, Río Unduani (near La Paz) is gray on the lores, superciliaries, sides of head, throat, and breast and pale ochraceous on the lower under parts which are only faintly barred with light gray, though black feathering is appearing on the anterior under parts; the sides of the upper back are sooty gray, not black, and the uropygium is grayish. Though darker than *caerulescens*, the resemblance is apparent. Some young males of *caerulescens* are ochraceous posteriorly and greatly resemble *gilviger*. I have only two skins of *connectens* and these appear to differ from other examples, including the type, described by Hellmayr

(Field Mus. Nat. Hist. Publ., Zool. Ser., XIII pt. 3, p. 104, footnote a, 1924), emphasizing the variability of this form which is certainly no more than a connecting link between *aspersiventer* and *paraguayensis*. One skin of *connectens* from Vermejo, Santa Cruz, Bolivia, is similar in many ways to one of *paraguayensis* from Fort Wheeler, Paraguay, though the latter is not typical but varies in the direction of *dinellii*.

Females show even better transition. Two females of *aspersiventer* from Locotal and Songo, Bolivia, with strongly brown backs and brown caps without any black, are but slightly more strongly colored on the lower under parts and have the face less whitish, but otherwise are not immediately distinguishable from some female *caerulescens*.

Thus the entire series appears to form a good specific group of which the darkest forms are found in the Andes, the next darkest on the eastern side of the continent, and the palest in the interior. More material of *connectens* is needed, particularly females. Since *caerulescens* is the oldest valid name in this group, it becomes the specific name and is here adopted.

Records of *melanchrous* from localities other than those listed below are Garita del Sol, Huiro, Paltaypampa, Eneñas, Vitoc, and Perú between 12° and 14° S. (=Junín region).

***Thamnophilus caerulescens subandinus* Taczanowski**

Thamnophilus subandinus TACZANOWSKI, 1882, P. Z. S. London, p. 29—Chachapoyas; Chirimoto; Tamiapampa (type said to be from Chirimoto); ♂; Warsaw Mus.; cf. Stolzmann and Domaniewski, 1927).

The present form is discussed with *T. c. melanchrous*. It has been recorded from Chachapoyas, Chirimoto, Tamiapampa, Utcubamba, and Leimebamba, in addition to some of the localities from which material is listed below.

The Chinchao birds may not be quite typical of *subandinus* but are probably best referable to this form which apparently ranges up the Huallaga along the left bank in the upper Tropical Zone.

SPECIMENS EXAMINED

T. c. caerulescens.—BRAZIL: (states of Rio and São Paulo), 12 ♂, 12 ♀.

T. c. gilvigator.—BRAZIL: Castro, Paraná, 1 ♂, 1 ♀; São Lázaro, Rio Grande do Sul, 1 ♂, 1 ♀.

T. c. paraguayensis.—PARAGUAY: Río Negro, 1 ♂, 2 ♀; Fort Wheeler, 1 ♂.

T. c. dinellii.—ARGENTINA: (Jujuy, Salta, Tucuman, and Chaco), 18 ♂, 13 ♀.

T. c. connectens.—BOLIVIA: Vermejo, Santa Cruz, 2 ♂.

T. c. aspersiventer.—BOLIVIA: Songo, 1 ♂, 1 ♀; "lower Beni," 1 ♂; Pitiguaya, 1 ♂, 1 ♀; Ticunguaya, 1 "♂" (= ♀); Roquefalta, 1 ♂; Incachaca, 3 ♂, 1 ♀; Locotal, 3 ♂, 1 ♀; Jatumpampa, 1 ♂¹.

T. c. melanchrous.—PERÚ: Santo Domingo, 2 ♂, 1 ♀; San Miguel Bridge, 2 ♀; San Miguel, 1 ♂, 1 ♀; Torontoy, 2 ♂, 2 ♀; Santa Rita, 1 ♂; Idma, 3 ♂, 3 ♀; Santa Ana, 1 ♀; Chelpe. Junín, 6 ♂, 4 ♀; Utcuyacu, 1 ♂, 2 ♀; Rumicruz, 2 ♂.

T. c. subandinus.—PERÚ: San Pedro, south of Chachapoyas, 2 ♂, 2 ♀; La Leija, 2 ♂, 2 ♀; Molinopampa, 2 ♂¹; Chinchao, 4 ♂¹, 1 ♀¹.

***Thamnophilus ruficapillus marcapatae* Hellmayr**

Thamnophilus marcapatae HELLMAYR, 1912 (January), Verhandl. Orn. Ges. Bay., XI, No. 1, p. 162—Chuhuasi, near Ollachea, Carabaya, 7000 ft., n. Puno, Perú; ♂; Munich Mus.

A series of twelve skins of this interesting form demonstrates a certain amount of variation in the intensity and extent of the markings, definitely in the direction of *T. n. subfasciatus*, as would be expected. Thus, while some of the adult males are deep Mouse Gray on the back, others have a more brownish tone; the flanks may have a brownish wash; the throat may be more or less distinctly, though obscurely, barred; the whole of the abdomen and under tail-coverts may be regularly barred, with the white bars exceeding the black ones in width; the tail may show white notches on both webs of the rectrices, visible even on the middle pair and sometimes nearly reaching the shaft on the inner webs of the outermost ones.

The females are, of course, quite deeply colored below though with some differences in actual hue, and vary widely in the amount of brown on the back. I have no female of *subfasciatus* but, judging by the original plate of the female cotype, it is paler than the females of *marcapatae* but not otherwise different.

Records of *marcapatae* are from Chuhuasi and Marcapata and it is possible that the male in the Raimondi collection, without locality, mentioned by Taczanowski as darker than a Cutervo specimen, belongs here also. Additional localities are given below. The Cutervo and Coccocho skins recorded by Taczanowski belong to the following form.

***Thamnophilus ruficapillus jaczewskii* Domaniewski**

Thamnophilus ruficapillus jaczewskii DOMANIEWSKI, 1924, Bull. Acad. Pol. Sci. Lettres, Cl. Sc. Math. Natur., Ser. B, p. 762—Cutervo, Perú; ♂; Warsaw Mus.

Thamnophilus ruficapillus borealis CARRIKER, 1933, Proc. Acad. Nat. Sci. Phila., LXXXV, p. 17—Leymebamba, 7000 ft.; Perú; ♂; Acad. Nat. Sci. Philadelphia.

A female from San Pedro, south of Chachapoyas, collected by Harry Watkins, is the first known example of this sex of the present form. It is very like the original figure of the female *subfasciatus* and must be

¹Specimens in Field Museum of Natural History, Chicago.

extremely close to that form as, indeed, is noted for the males by Domaniewski and Carriker. Since the female has not been described heretofore, the following account may be serviceable. Top of head to hind neck light Bay; forehead narrowly tinged with buff. Back Argus Brown x Amber Brown; wings dusky brown with outer surface of closed wing dark Sanford's Brown; tail largely Sanford's Brown x Chestnut; middle rectrices darker but outermost pair paler with six obsolete dusky bars (strongest distally) and a buffy tip; these markings suggested on the other rectrices, especially the outer ones. Lores dull ochraceous with dusky tips; superciliary region lighter, less buffy; auriculars buffy gray; sides of neck still more grayish. Under parts deep ochraceous-cinnamon, paler on throat, much paler on belly (Cinnamon-Buff), and darker on sides, and with traces of fine dusky bars faintly visible; flanks Tawny-Olive; under tail-coverts like breast and similarly with obsolete dusky bars; under wing-coverts deep Ochraceous-Buff; inner margins of remiges Light Pinkish Cinnamon. Bill blackish (in dried skin), with distal half of mandible bluish white; feet slaty. Wing, 70 mm.; tail, 64; exposed culmen, 15; culmen from base, 20; tarsus, 27.5.

SPECIMENS EXAMINED

T. r. jaczewskii.—PERÚ: San Pedro, south of Chachapoyas, 1 ♀.

T. r. marcapatae.—PERÚ: Inca Mine, 2 ♂, 3 ♀; Santo Domingo, 5 ♂, 1 ♀; Oconeque, 1 ♂.

T. r. subfasciatus.—BOLIVIA: Nequejahuirá, 1 ♂.

T. r. cochabambae.—BOLIVIA: Tujma, 8 ♂ (incl. type), 7 ♀; Valle Grande, 1 ♀. ARGENTINA: Perico, Jujuy, 1 ♂.

T. r. ruficapillus.—ARGENTINA: Quilmes, 1 ♂; Barracas al Sur, 1 ♂; La Plata, 1 ♀; Concepción del Uruguay, 1 ♂. BRAZIL: Monte Serrat, 2 ♂, 1 ♀; alto Itatiaya, 1 ♂, 2 ♀; Ypanema, 1 ♂; Taquara do Abundo Novo, Rio Grande do Sul, 1 ♂.

NOTE

Thamnophilus sp.? TACZANOWSKI, 1874, P. Z. S. London, p. 530—"Tambapota."

Taczanowski recorded two females as indicated but made no future reference to them under this or any other species of the Formicariidae. Apparently they were the only specimens of this family collected by Jelski at this locality and any references under another name within the group are likely to refer to this record, but I have been unable to find them if they exist. The locality is equally obscure. Taczanowski makes mention of it variously, in other connections, as Tempobata and Tambopata, and it is probable that the last-named spelling is correct, though it is doubtful if it has anything to do with the Río Tambopata in

southeastern Perú since it is included among the localities visited by Jelski while collecting in the Junín region.

There is no assurance that Taczanowski's record belongs in *Thamnophilus*. The two females probably were never afterward identified by him and the account must stand as given until the specimens come to light for study.

AMERICAN MUSEUM NOVITATES

Number 648

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

July 21, 1933

59.86, 5 Z

A STUDY OF *ZENAIIDA AURICULATA*

BY ELSIE M. B. NAUMBURG

INTRODUCTION

In working on the Kaempfer Collection from northeast Brazil, I had to identify certain doves from the genus *Zenaida*. It soon became evident that this group was much in need of revision, and the results of my studies are presented in the following paper.

In all races of the species *Zenaida auriculata*, females differ from the males in the generally duller coloration with less metallic gloss on nape and sides of neck; the rosy color on forehead, sides of head, and throat is dingier and shaded with buff; the gray on the posterior crown almost entirely concealed by brownish margins; the pinkish or vinaceous of the breast is more or less obscured by brownish edges; while the abdomen and under tail-coverts are at least partly buff.

Young birds are much duller in coloration than the adult female, the occiput is duller, the underparts are duller, and sometimes the coloration is very different from the adults. Wing-coverts and scapulars are edged terminally (sometimes more or less distinctly) with pale, wedge-shaped streaks or dull white. The chest-feathers of the juvenal birds also have paler edges and narrow wedge-shaped streaks and exhibit no reflection.

The tail is mostly moderate and rounded. The rectrices have a broad postmedian bar of black (except the middle pair of tail-feathers). The basal portion is darker gray or brown; the apical portion pale gray, cinnamon, rufous, or white.

There is always a bare orbital space beneath the eye, a black spot, more or less metallic, beneath the ear-coverts, and a black spot behind the eye. There are black spots on the innermost secondaries.

There are variations in color and size that distinguish specimens from different geographic areas. Racial characters are better developed in the male sex, females often being barely distinguishable.

The principal area of intergradation is found along the estuary of the Amazon, Marajó, Mexiana, and the coast of Maranhão. The race found there, *Zenaida auriculata marajoensis*, is intermediate between its geographical neighbors, combining the white apical tail-markings of one "species" with the deep vinaceous underparts of another.

In the Temperate Zone of the Magdalena, *Zenaida auriculata antioquiae* appears to replace the Tropical Zone race, *Zenaida auriculata rubripes*, just as *Zenaida auriculata ruficauda* does in the Temperate Zone of the eastern Colombian Andes, both being altitudinal representatives. The upper Cauca form with white tail-tips and under tail-coverts is much nearer the Ecuadorian and Peruvian form, *Zenaida auriculata hypoleuca*, this being quite plausible from a geographical point of view. The fact that *Zenaida auriculata antioquiae* is found west of the lower Magdalena is no obstacle for considering the various forms as members of one taxonomic unit.

The task of writing this paper and identifying the specimens was not easy because the series available was small, and much of the value of this revision may be credited to the assistance given me by Dr. C. E. Hellmayr.

The writer went to Vienna in September, 1932, to verify some statements made in this paper and to examine and measure additional specimens.

Zenaida auriculata auriculata (Des Murs)

Peristera auriculata DES MURS, 1847, in Gay, 'Hist. Fis. Pol. Chile,' Zool., I, p. 381, Pl. VI (Chile); "en las provincias centrales de la República." I suggest Santiago as type locality.¹

SUBSPECIFIC CHARACTERS.—Characterized chiefly by its large size, and in the male sex by almost uniform vinaceous underparts, the abdomen as well as the breast being of this color. Under tail-coverts white.

RANGE.—Chile: from Atacama south at least to the Rio Aysen.

SPECIMENS COLLECTED

Kaempfer Collection

Northeast Paraguay: Dept. Concepción, Zanja Moroti (alt. 1000 ft.), 1 ♂ ad., Sept. 8, 1930.

Rio Grande do Sul: Palmares (sea-level), 2 ♂, 1 ♀ ad., Oct. 13, 1928, 1 ♀ ad., Oct. 7, 1928; Candiota, 1 ♂ ad., Sept. 9, 1931.

Measurements

	SEX	WING	TAIL	EXPOSED		COLL.	MUS.
				CULMEN			
Chile: Tofo, north of Coquimbo	♂ ad.	159.5	103	14.5		Hallinan	A.M.N.H
" " " " "	♂ "	154	95	14		"	"
" " " " "	♀ "	140	85	15		"	"
" Prov. Santiago	♂ "	160	105	14		Davila	Vienna ²
" Romero, Prov. Coquimbo	♂ "	146	91.5	15		Conover	Field

¹Middle of the range.

²One immature female was examined in the Vienna Museum from Chile (Desague, Prov. Llanguhue).

	SEX	WING	TAIL	EXPOSED		MUS.
				CULMEN	COLL.	
Chile: Hacienda Cauquenes,						
Prov. Colchagua	♂ im.	143.5	89.5	15	Conover	Field
" " " "	♂ "	144	93.5	14.5	"	"
" " " "	♀ ad.	148	97	15	"	"
" " " "	♀ "	145	98	15	"	"
" " " "	♀ im.	140.5	83	15.5	"	"
" Río Nirehuau, Casa de						
Richards, Prov.						
Llanquihue	♂ im.	152.5	95	15	"	"
" " " "	♂ "	147.5	87	15.5	"	"
" " " "	♂ "	150	85	17.5	"	"
" " " "	♀ "	151	103.5	14	"	"
" Río Cohaique, Estancia						
Asien, Prov. Llanqui-						
hue ¹	♂ ad.	151	101.5	15	"	"
" Concepción, Prov. Con-						
cepción	♂ "	152.5	97	15	"	"
" Concon, Prov. Val-						
paraiso	♀ "	142.5	92	16	"	"
Argentina: Tunuyán, Prov.						
Mendoza	♂ "	144	95.5	15	"	"
" " " "	♂ "	142.5	97	16	"	"
" " " "	♀ "	146	84	14	"	"

Zenaida auriculata virgata Bertoni

Zenaida virgata BERTONI, 1901, Anal. Cient. Parag., I, p. 24; Alto Paraná, Paraguay.

Zenaida maculata PELZELN, 1870, 'Orn. Bras.,' III, p. 276; São Paulo, Paraná, and Matto Grosso.

SUBSPECIFIC CHARACTERS.—Smaller than typical *auriculata*; anterior underparts in the male sex deeper vinaceous, becoming paler posteriorly and passing into buffy white on under tail-coverts.

RANGE.—Bolivia; Argentina; Paraguay; Uruguay; and southern Brazil, from Rio Grande do Sul north to São Paulo, Minas Geraes, and Matto Grosso.

Measurements

	SEX	WING	TAIL	EXPOSED		MUS.
				CULMEN	COLL.	
Paraguay: Fort Wheeler	♀ ad.	132.5	82	16	Roos.	A.M.N.H.
" Trinidad	♀ "	134	80	15	"	"
Brazil: Matto Grosso Chapada	♂ "	133	83	15	Smith	"
" " " "	♀ "	139	82.5	15	"	"
" Villa Bella de Matto						
Grosso	♂ "	134	93	15	Natterer	Vienna
" Matto Grosso, Cuyabá	♂ "	138	94	14	"	"

¹Birds from Mendoza (Tunuyán) appear to be identical with the Chilean form.

	SEX	WING	TAIL	EXPOSED CULMEN	COLL.	MUS.
Brazil: Minas Geraës, Lagoa Santa	♂ ad.	143	84	14	Lund	Zool. Mus. ¹ Copenhagen
" " " "	♀	132	82	14	"	" " "
Bolivia: Parotani, Prov. Cochabamba	♂	153	93	14	Collins-Day	A.M.N.H.
" California, Prov. Santa Cruz	♂	152	102	16	Miller-Boyle	
" Vermejo, Santa Cruz	♂	140	87	15	"	"
" Vinto, Prov. Cochabamba	♂	145	93.5	14	"	"
N. E. Paraguay: Dept. Concepción, Zanja Moroti	♂	143	92	16	"	"
Argentina: Mendoza	♂	152	97	16	Dinelli	"
" "	♂	150	94	16.5	"	"
" La Plata	♂	142	87	15	"	"
" "	♂	135	84.5	15	"	"
" Mar del Plata	♂	146	91	14.5	Beck	"
" Buenos Aires	♂	146	92	16	Chapman-Miller	
" " "	♂	142	87	15	"	"
" Rosario de Lerma, Prov. de Salta	♂	145	93	2	Miller-Boyle	"
" Tafi del Valle, Prov. Tucuman	♂	150	95.5	14.5	"	"
Brazil: Rio Grande do Sul, Palmares	♂	144	82	15	Kaempfer	A.M.N.H.
" " " "	♂	140	93.5	15	"	"
" " " "	♀	141	90.5	14	"	"
" " " "	♀	139	86	14	"	"
" Rio Grande do Sul, Candiota	♂	141.5	88.5	14.5	"	"
" " " "	♂	136	100	16	Natterer	Vienna
" " " "	♀	138	95	15	"	"
" Parana, Curytiba	♂	136	94	15	"	"
" " " "	♂	136	86	17	"	"
" " " "	♀	129	90	14.5	"	"
" " Rio Boraxado	♂	133.5	98	14.5	"	"
" " " "	♀	133	91	17	"	"

¹Through the courtesy of Prof. R. Hørring, of the Zoological Museum in Copenhagen, who sent me two specimens from Lagoa Santa, Minas Geraës, I was able to compare these specimens with our series of *Zenaida auriculata virgata* with which they agree.

*Culmen broken.

Zenaida auriculata noronha Chubb

Zenaida auriculata noronha CHUBB, 1919, Ibis, I, p. 36 (Fernando Noronha Island).

SUBSPECIFIC CHARACTERS.—About the same size as *Z. a. virgata*, but anterior underparts of males decidedly paler vinaceous pink, and abdomen, like under tail-coverts, entirely or for the greater part buff or buffy white; females hardly distinguishable.

RANGE.—Northeastern Brazil, in State of Bahia, interior of Piahy and Maranhão, and Fernando Noronha Island.

SPECIMENS COLLECTED

Kaempfer Collection

Maranhão: Flores, on the Rio Parnahyba, 1 ♂, Sept. 30, 1926. Piahy: Corrente (alt. 1500 ft.), 2 ♂ ad., June 4 and 9, 1927. Bahia: Barra do Rio Grande (alt. 1400 ft.), 3 ♂ ad., April 20, 21, 28, 1927, 1 ♀ ad., May 14, 1927; Santa Rita do Rio Preto (alt. 1600 ft.), 1 ♂ ad., 1 ♀ ad., Aug. 14, 1927.

Measurements

	SEX	WING	TAIL	EXPOSED	COLL.	MUS.
				CULMEN		
Brazil: Maranhão, Flores	♂ ad.	138	85.5	14.5	Kaempfer	A.M.N.H.
" Piahy Corrente [alt.	♂	"	"	"	"	"
1500 ft.)	♂	134	80	15.5	"	"
" " " "	♂	130	79	14	"	"
" Bahia, Barra do Rio	♂	"	"	"	"	"
Grande (alt. 1400 ft.)	♂	136.5	83	15.5	"	"
" " " "	♂	131.5	80	15	"	"
" " " "	♂	130	76.5	15	"	"
" Santa Rita do Rio Preto	♂	"	"	"	"	"
(alt. 1600 ft.)	♂	136	81.5	15	"	"
" Fernando Noronha Isl. ¹	♂	135	87	16	Murphy	"
" " " "	♂	138	83	17	"	"
" Bahia, Piripiri near	♂	"	"	"	"	"
Joazeiro	♂	130	85	16.5	Reiser	Vienna
" " Joazeiro	♂	131	70	18	"	"
" Piahy, San Antonio de	♀	"	"	"	"	"
Gilbuez	♀	131	89	15	"	"
" Piahy, south end of Lake	♀	"	"	"	"	"
Parnaguá	♀	128	81	16	"	"
" Piahy, Pedrinha, Lake	juv. ♂	"	"	"	"	"
Parnaguá	juv. ♂	132	85	15	"	"
" Piahy, Ibiapaba	♂	139.5	82	15	H. Snethlage	Field
" " Arara	♂	135	81.5	15	"	"
" " " "	♂	135	81	15	"	"
" Bahia, Rio do Peixe near	♂	"	"	"	"	"
Queimadas,	♂	136	85.5	14.5	R. H. Becker	"
" " " "	♂	131	80	15	"	"
" " " "	♀	132	80.5	16	"	"

¹Dr. Hellmayr has examined two males in the British Museum from Fernando Noronha: wing, 135, 138; tail, 80, 86.

JUVENAL PLUMAGE

A young male in the Vienna Museum (Reiser Coll.), No. 768, has the feathers of the upperparts with white wedge-shaped edges. The primaries and primary coverts have the same white wedge-shaped marks.

Another young bird, No. 780, lacks all wedge-shaped white marks to the edges of the feathers. This bird differs from the normal juvenal plumage by having the chest-feathers sooty with pale cinnamon shaft-streak and apical margin. It appears to be an abnormal plumage as was already noted by the collector, Mr. Othmar Reiser. This may be melanistic, as sometimes occurs in pigeons.

Zenaida auriculata marajoensis Berlepsch

Zenaida jessiae marajoensis BERLEPSCH, 1913, Ornith. Monatsber., XXI, p. 149 (Hacienda São André, Island of Marajó; type in Senckenbergian Mus. Frankfurt, examined).

Zenaida jessiae consp. nov., E. SNETHLAGE, 1911-1912, Bol. Mus. Goeldi, VIII, p. 64 (Marajó).

SUBSPECIFIC CHARACTERS.—Slightly smaller than *Z. a. noronha*, and much deeper vinaceous below, this color extending all over the abdomen and under tail-coverts.

RANGE.—Estuary of the Amazon, from Marajó and Mexiana to coast of Maranhão, (Anil, Ilha do São Luiz).

SPECIMENS COLLECTED

Maranhão; Anil, Ilha São Luiz, 2 ♂ ad., 1 ♀ ad., 2 sex (?), Feb. 23, 24, 26, 1916; Emil Kaempfer.

Zenaida a. marajoensis is closely related to *Z. a. jessiae*, but has the tips of the four lateral pairs of rectrices nearly pure white, at best with a narrow grayish outer margin. It approaches *Z. a. noronha* in coloration of tail-tips, but is decidedly deeper vinaceous underneath, and the males lack the buff on lower abdomen and tail-coverts, these parts being merely somewhat paler vinaceous than the breast. It will thus be seen that this race is intermediate between its geographical neighbors, combining the white apical tail markings of *noronha* with the deep vinaceous underparts of *jessiae*.

Count Berlepsch laid much stress on the presence of the black post-ocular streak that, according to him, served to distinguish *marajoensis* and *jessiae* from what he calls *Z. auriculata* (comprising *auriculata* and *noronha* of the present paper). Dr. Hellmayr says that, while this streak is well marked in all the specimens from northern Maranhão and lower Amazonia and frequently absent in the more southern forms, there are nevertheless a good many individuals from southern Brazil, Argentina,

etc., that cannot be separated by this character from northern examples, and it would therefore appear that it is only of relative value.

This well-defined form is not an island race, but seems to be distributed from the islands in the estuary of the Amazon through the coastal districts of Pará and Maranhão.

Measurements

	SEX	WING	TAIL	EXPOSED	COLL.	Mus.
				CULMEN		
Brazil: Maranhão, Anil, Ilha						
São Luiz	♂ ad.	135	88	15	Kaempfer	A.M.N.H.
" " " "	♂ "	131	84.5	15	"	"
" " " "	♀ "	127	77	14	"	"
" " " "	?	127	73	16.5	"	"
" " " "	?	129	76.5	15	"	"
Isle of Marajó: San Natal	♂ "	135	82	14		Munich
" " " "	♂ "	132	80	15		"
" " " "	♀ "	125	76	14		"
" " " Hacienda St.					Bluntschli-	
André (type)	♂ "	135	87 ¹	15	Payer	Frankfurt
" "	♀ "	125	79	15	"	"
" " " Boa Vista	♂ "	135	87	16		Tring
Brazil: Pará	♀ "	132	80	15		British

Zenaida auriculata jessieae Ridgway

Zenaida jessieae (Riker MS.) RIDGWAY, 1887, Proc. U. S. Nat. Mus., X, p. 527; (Diamantina), near Santarem east of mouth of Rio Tapajóz, Brazil.

Zenaida jessieae SNETHLAGE, 1914, Bol. Mus. Goeldi, VIII, p. 63 (Ereré).

SUBSPECIFIC CHARACTERS.—Similar to *Z. auriculata marajoensis* in deep vinaceous underparts, but terminal portion of lateral rectrices tinged with pinkish or pale vinaceous instead of white.

RANGE.—Banks of the lower Amazon (Santarem, Diamantina, and Paricatúba), south bank; Ereré, near Montalegre, north bank.

This form, though very close to *Z. a. marajoensis*, is apparently separable by the coloration of the tail-tips which are tinged with delicate rose-color on the two outermost pairs of rectrices, gray shaded with pale vinaceous on the third, and dark gray on the fourth; whereas, in the allied race, the corresponding portion of the four lateral pairs is white with little, if any, gray along the external margin. The underparts are deep vinaceous down to the abdomen, passing into pinkish buff in the middle of the lower belly in the female sex, just as in *Z. a. marajoensis*. However slight, the difference pointed out above seems to have geo-

¹Tail in bad condition when examined in Frankfurt (Senck. Naturwiss. Gesell.)

graphical significance, inasmuch as the vinaceous tinge on the apical portion of the tail marks a decided step in the direction of the next form. *Z. a. jessiae* obviously replaces the preceding race (*marajoensis*) on the banks of the lower Amazon wherever there are stretches of open country.

From information sent to me by Dr. C. E. Hellmayr, it was first recorded by Allen¹ under the erroneous name *Z. ruficauda* from Santarem, where Linden met with it in small flocks on the campo, but its distinctness was not recognized until 1887 when Riker forwarded three specimens from Diamantina, in the vicinity of Santarem, to the U. S. National Museum. W. A. Schulz obtained a single example at Paricatúba, on the south bank of the Amazon, a little west to the junction of the Tapajóz. However, this dove also occurs on the opposite side of the Amazon, since a female secured by O. Martins at Ereré near Montalegre (north bank) was found by Hellmayr to be identical with birds from near Santarem.

Measurements

	SEX	WING	TAIL	EXPOSED		COLL.	MUS.
				CULMEN			
Brazil: Santarem, Rio Amazon	♂ ad.	127.5	85	13.5			Carnegie
" " " "	♂ "	132.5	85.5	14			"
" " " "	♀ "	134.5	85.5	15			"
" " " "	♀ "	132	85.5	13.5			"
" Paricatúba, " "	♀ "	132	81	15	Schulz		Frankfurt
" Ereré " "	♀ "	130.5	78.5	14	Paraense		Goeldi
					Riker		
" Diamantina, Rio Tapajóz	♂ "	131	77.5	15			U. S. Nat.
" " (type)	?	130	72	15	"		"
" " "	?	123	80.5	15			"

Zenaida auriculata rubripes Lawrence

Zenaida rubripes LAWRENCE, 1885, The Auk, II, p. 357 (Grenada, Lesser Antilles).

Zenaida ruficauda robinsoni RIDGWAY, 1915, Proc. Biol. Soc. Wash., XXVIII, p. 107 (Honda, Colombia).

SUBSPECIFIC CHARACTERS.—About the same size as *Z. a. jessiae*, and underparts from lower throat to tail-coverts very nearly as deep vinaceous but terminal portions of five lateral rectrices bright vinaceous cinnamon. Besides, chin and middle of upper throat are paler (from light pinkish buff to buffy white), and the dorsal surface is slightly paler brown. Differs from *Z. a. vinaceo-rufa* in being darker brown above and deeper vinaceous below with a cinnamonaceous tinge, and in having a buff instead of a clear and well-defined white chin-spot.

¹1878, Bull. Essex Inst., VIII, p. 82.

RANGE.—Southern Lesser Antilles (Grenada, Glover's Island,¹ Carriacou)²; British Guiana (Annai, Quonga); Venezuela, from the north coast including Margarita Island, south to the Orinoco River and its tributaries; extreme northern Brazil (upper Rio Branco); eastern Colombia (Honda and Chicoral, Magdalena Valley).

Ridgeway,³ who originally based the description of *Z. r. robinsoni* upon specimens from Honda, Magdalena Valley, subsequently gave its range as comprising the "interior districts of Colombia and Venezuela," whereas the "arid coast" of Venezuela and the islands of Margarita, Curaçao, Aruba, Bonaire, Grenada, and Carriacou were indicated as constituting the distributional area of *Z. r. vinaceo-rufa*, the type of which came from Curaçao. The difference between the two races was stated to consist of the intensity of coloration, *robinsoni* being darker, more brownish above and more vinaceous below.

Critical examination of large series of these doves, however, tends to show that such an arrangement does not correctly express actual conditions. Birds from the Venezuelan coast district (Barquisimeto and El Cuji, Estado Lara) and Margarita Island are nowise different from others collected on the banks of the Orinoco and Caura rivers and, furthermore, agree in size and coloration with a series from the southern Lesser Antilles (*Z. rubripes*). Even topotypical specimens of *Z. r. robinsoni* from the Magdalena Valley are inseparable, though one would naturally expect to find another race in this part of Colombia. The earliest name of this form thus is *Zenaida auriculata rubripes*, of which *Zenaida ruficauda robinsoni* becomes a synonym.

The large series from the Dutch West Indies (Curaçao, Aruba, Bonaire) courteously loaned by the Field Museum of Natural History averages lighter and clearer in color than the bird I now call *Zenaida auriculata rubripes*, the latter being much deeper vinaceous below, though varying in degree of intensity. The paler brown upperparts constitute an absolutely constant character of *Z. a. vinaceo-rufa* as restricted here to the Dutch West Indies.

Nevertheless, individual variation occasionally obliterates the distinctive features, and a specimen from Caicara, Rio Orinoco, a bird in very fresh and unworn plumage, is practically indistinguishable from Bonaire and Curaçao examples. An individual from Agua Salada de Ciudad Bolivar, Orinoco, is much the darkest in the whole series, but

¹Of. Wells, 1887, Proc. U. S. Nat. Mus., IX, p. 624. It is inconceivable why the Grenada people call this dove "Trinidad ground dove" since no dove of this section ever occurred on Trinidad. (Note given to me by Dr. C. E. Hellmayr.)

²Of. Austin H. Clark, 1905, 'Birds of the Southern Lesser Antilles,' Proc. Boston Soc. Nat. Hist., XXXII, No. 7, pp. 203-312.

³Bull. U. S. Nat. Mus., L, part 7, p. 356.

close inspection shows this to be caused by grease, the bird having been exceedingly fat when killed.

Birds from the upper Rio Branco¹ are, so far as coloration is concerned, identical with the Venezuelan series, but average very slightly smaller.

No material has been available from the Mérida region of Venezuela, but the doves from this section are not likely to be different from *Z. a. rubripes*.

Measurements

	SEX	WING	TAIL	EXPOSED CULMEN	COLL.	Mus.
Lesser Antilles: Beausejour Flat	♂ ad.	130	91	14		Vienna
" " " "	♂ "	132	85	13.5		Comp. Zool.
" " " "	♂ "	130	83	14.5		"
" " " "	♂ "	133.5	87	15		"
" " " "	♀ "	130	86.5	15		"
" " " Carriacou	♂ "	139	89	15	F. F. Dall	Frankfurt
" " " "	♂ "	137	87	15		"
" " " "	♂ "	138	87.5	16.5		"
" " " "	♀ "	134	85.5	15.5		"
" " " "	♀ "	135	82.5	14.5		"
Island of Trinidad ² : Caroni Swamp	?	131	85	14.5	G. D. Smooker	U.S.Nat.
Lesser Antilles: Grenada, Pt. Sabine	♀ "	130.5	85.5	13		A.M.N.H.
" " Grenada	♂ "	138.5	90	15		"
" " " "	♂ "	136.5	86	13.5		Field
" " " "	♂ "	136	81.5	15		"
British Guiana: Annai, Quonga,	♂ "	128	80	14	Whitely	Frankfurt
" " " "	♂ "	125	85.5	14	"	U.S. Nat.
Venezuela: Maripa, Caura River	♂ "	127	90	14.5	Klages	A.M.N.H.
" Cuidad Bolivar,						
" Orinoco	♂ "	135	86.5	15	"	"
" Agua Salada de Ciudad Bolivar, Orinoco	♂ "	135	94	15	Cherrie	"
" Caicara, Rio Orinoco	♂ "	132	88.5	13	"	"
" " " "	♀ "	136	85	15	"	"

¹Birds from the interior of British Guiana (Annai, Quonga) resemble those from the Rio Branco in size and coloration.

²According to Dr. Alexander Wetmore the specimen from the Caroni Swamp, Trinidad, was taken May 27, 1932, with a set of two eggs, by G. D. Smooker and was presented by him to the U. S. Nat. Mus. It is generally similar to the specimens from the mainland of Venezuela except as it appears somewhat grayer on the back, rump, and wing-coverts. With only one specimen at hand from Trinidad it would seem that this difference is probably individual variation. Mr. Smooker's specimen is of particular interest since at this time it is the only one reported from the Island of Trinidad, the locality from which these birds were supposed to be absent.

	SEX	WING	TAIL	EXPOSED CULMEN	COLL.	Mus.
Venezuela: Barquisimeto, Estado					Cherrie	A.M.N.H.
" " " " Lara	♂ ad.	136	85	15	"	"
" " " " "	♂ "	132	85	15	"	"
" El Cují, Estado Lara	♂ "	143	90	15	"	"
Colombia: Honda	♂ "	133	88.5	15.5	Chapman-	"
" " " " "	♂ "	136	92.5	15	Cherrie	"
" " " " "	♂ "	131.5	87.5	15	"	U.S. Nat.
" " (type)	♂ "	142.5	85	16.5	"	"
" Chicoral, Coello River,					"	
Tolima	♂ "	136.5	80	15	Allen-Miller	A.M.N.H.
" Margarita Island	♂ "	138.5	93.5	14		Field
" " " " "	♂ "	140	89	16.5		U. S. Nat.
" " " " "	♂ "	138.5	91	1		"
" " " " "	♂ "	138	90.5	14.5		"
" " " " "	♀ "	140.5	80.5	14.5		"
Brazil: Boa Vista, Rio Branco	♂ "	132.5	85.5	15		Field
" " " " "	♂ "	131.5	76.5	15.5		"
" " " " "	♂ "	127	77	15		"
" Forte de Rio Branco	♂ "	129	90.5	14	Natterer	Vienna
" " " " "	♂ "	128	93	13.5	"	"
" " " " "	♂ "	127.5	90	15	"	"
" " " " "	♀ "	126.5	91	16.5	"	"
" " " " "	♀ "	127	93.5	15.5	"	"

Zenaida auriculata vinaceo-rufa Ridgway

Zenaida vinaceo-rufa RIDGWAY, 1884, Proc. U. S. Nat. Mus., VII, p. 176 (Curaçao Island, Dutch West Indies).

SUBSPECIFIC CHARACTERS.—Coloration paler throughout, considerably less brownish above and less deeply vinaceous below than *Z. a. rubripes*, with a clear white instead of a pale buffy chin-spot.

RANGE.—Dutch West Indies (Curaçao, Aruba, Bonaire).

This subspecies has the underparts pale vinaceous without a trace of cinnamon. The chin-spot is white and the upperparts are pale brown, both of these characters appearing to be quite constant, whereas the pale vinaceous color of the underparts is a variable character.

¹Bill broken.

Measurements

					SEX	WING	TAIL	EXPOSED CULMEN	MUS.
Dutch West Indies: Bonaire Island					♂ ad.	132	100	16	A.M.N.H.
"	"	"	"	"	♂ "	134.5	91.5	14.5	Field
"	"	"	"	"	♂ "	134	88.5	1	"
"	"	"	"	"	♂ "	135	89	14.5	"
"	"	"	"	"	♂ "	137	87	14.5	"
"	"	"	"	"	♂ "	134	86	14.5	"
"	"	"	"	"	♂ "	132	95	13.5	"
"	"	"	"	"	♂ "	137.5	91.5	14.5	"
"	"	"	"	"	♀ "	125	80.5	14	"
"	"	"	Curaçao	"	♂ "	137.5	87.5	15	"
"	"	"	"	"	♂ "	134	91.5	15	"
"	"	"	"	"	♂ "	131.5	85.5	16.5	"
"	"	"	"	"	♀ "	127	84.5	13	"
"	"	"	"	"	♀ "	131	81.5	14.5	"
"	"	"	Aruba	"	♂ "	132	80.5	15.5	"
"	"	"	"	"	♂ "	136	92.5	15.5	"
"	"	"	"	"	♂ "	133.5	88	14	"
"	"	"	"	"	♂ "	135	95	15.5	"

Zenaida auriculata antioquia Chapman

Zenaida auriculata antioquia CHAPMAN, 1917, Bull. Amer. Mus. Nat. Hist., XXXVI, p. 207 (Central Andes, Antioquia).

SUBSPECIFIC CHARACTERS.—Similar to *Z. a. rubripes*, but terminal portion of rectrices paler vinaceous-buff; dorsal surface decidedly darker brown; and dimensions considerably larger. Not unlike *Z. a. ruficauda*, but smaller; posterior underparts much more vinaceous, about the same color as the breast, instead of orange-cinnamon.

RANGE.—Temperate Zone of the northern end of the central Andes of Colombia, in State of Antioquia (Barro Blanco, Retiro, La Ceja, etc.).

The occurrence of this form west of the lower Magdalena does not affect the idea of considering the various forms as members of one taxonomic unit. Barro Blanco and La Ceja are in the Temperate Zone, where *antioquia* appears to replace the Tropical Zone *rubripes*, just as *ruficauda* does in the Temperate Zone of the east Colombian Andes.

Measurements

					SEX	WING	TAIL	EXPOSED CULMEN	Coll.	MUS.
Colombia: Barro Blanco, Antioquia					♂ ad.	148.5	104	17	Miller-	A.M.N.H.
"	"	"	"	(alt. 7200 ft.)	♂ "	147.5	103	15.5	Boyle	"
"	La Ceja				♂ "	143	96.5	14	"	"

¹Culmen broken.

Zenaida auriculata ruficauda Bonaparte

Zenaida ruficauda BONAPARTE, 1854, 'Consp. Av.,' II, p. 83 (New Grenada; type in British Museum).

Zenaida pentheria BONAPARTE, 1854, 'Consp. Av.,' II, p. 84 ("Santa Marta," errore; type in Paris Museum).

Zenaida bogotensis LAWRENCE, 1885, The Auk, p. 358 (Bogotá; type in A.M.N.H.).

SUBSPECIFIC CHARACTERS.—Nearest to *Z. a. antioquiae*, but somewhat larger; terminal portion of rectrices orange-cinnamon instead of vinaceous; abdomen and under tail-coverts bright cinnamon, decidedly more rufous than the vinaceous breast. Easily distinguishable from *Zenaida a. rubripes* by much larger size, darker brown upperparts, orange-cinnamon instead of vinaceous buff tail-tips, and much deeper and more rufous (less vinaceous) posterior underparts.

RANGE.—Temperate Zone of the eastern Andes of Colombia, in State of Cundinamarca (Bogotá savanna).¹

Though up to this time of writing *Z. ruficauda* has been considered specifically distinct from *Z. a. auriculata*, I have come to the conclusion that *Z. ruficauda* is only a geographic race in Colombia of *Z. a. auriculata*. The distinguishing character of *Z. a. ruficauda* lies in the terminal portion of the outer tail-feathers being decidedly rufous instead of white, as in *Z. a. auriculata*. *Z. a. ruficauda* is also larger.

Compared with *Z. a. vinaceo-rufa* from the Dutch West Indies, *Z. a. ruficauda* is also larger, with the under tail-coverts cinnamon without any vinaceous tinge, whereas *Z. a. rubripes* has all the lower parts distinctly vinaceous.

Two forms of this species occur in the Bogotá region, one in the semi-arid Tropical Zone of the upper Magdalena Valley (*Zenaida a. robinsoni* = *Zenaida a. rubripes*) the other a bird of the Temperate Zone. Common on the Bogotá savanna (*Z. a. ruficauda*).²

¹It is possible that its range extends to the Mérida region of Venezuela. I have not been able to procure any material from any museum. There is a record of a young bird in the British Museum.

²Dr. Hellmayr writes that *Z. pentheria* Bonaparte corresponds to the form here named *Z. a. ruficauda*. On comparing the type in the Paris Museum with topotypes of both *antioquiae* and "*robinsoni*" and specimens from the Bogotá savanna he found it to agree with the last-named in dimensions (wing, 158; tail 110; bill, 16 mm.), as well as in coloration (orange-cinnamon tail-tips; deep bright cinnamon lower abdomen and under tail-coverts, etc.).

Although Bonaparte gives its habitat "Santa Marta," the type bears no other locality than "Colombia" and the catalogue of entry in the Paris Museum does not supply any additional information. The collector, Mr. Fontainer, presented to the French National Collection birds from various parts of Colombia. Bonaparte (1856, C. R. Acad. Sci., XLIII, p. 946) explained how the mistake of describing

Measurements¹

	SEX	WING	TAIL	EXPOSED CULMEN	Coll.	Mus.
Colombia: Bogotá (type)	?	159.5	112	16	A. Maria	A.M.N.H.
" "	?	159	110	16	"	"
" "	?	156	113	16	"	"
" " Pipiral	?	150.5	110	17.5	"	"
" " (savanna), E. Andes	♀ ad.	143	78.5	16.5	"	"
" " " "	♀ "	153	105	15	"	"

Zenaida auriculata caucae Chapman

Zenaida auriculata caucae CHAPMAN, 1921, Amer. Mus. Novitates, No. 31, p. 1 (Cali, Colombia).

SUBSPECIFIC CHARACTERS.—Similar to *Z. a. auriculata* but smaller in size, darker brown above, and underparts deeper vinaceous; under tail-coverts buffy vinaceous, as in *Zenaida a. auriculata*.

RANGE.—Colombia: Cauca, Cali.

In the Cauca Valley a return to the Chilean form is made, the bird having the abdomen vinaceous as in typical *Z. a. auriculata* and closely resembling that race, except in being slightly smaller. This upper Cauca form (*Z. a. caucae*) with white tail-tips and under tail-coverts is also near *hypoleuca*, this being quite plausible from a geographical point of view. On comparing the birds from Cauca (Cali) with three specimens of *Zenaida auriculata auriculata* from Argentina, Tunuyán, Province of Mendoza, I found the Colombian specimen practically indistinguishable, averaging slightly smaller, however. Birds from the Cauca Valley differ from *Zenaida auriculata hypoleuca* in being darker vinaceous on forehead, sides of the head, and breast, as well as in the deeper olive-brown color of the upperparts; flanks, axillaries, and under wing-coverts are darker gray; abdomen, crissum, and under tail-coverts have a deeper vinous tinge. The birds from Cauca also average smaller in size.

Measurements²

	SEX	WING	TAIL	EXPOSED CULMEN	Coll.	Mus.
Colombia: Cauca, Cali (3600 ft.)	♂ ad.	143	98	13	Richardson-	A.M.N.H.
" " " " "	♂ "	138.5	95	14.5	Miller	"
" " " " "	♀ "	133.5	87	15.5	"	"

¹*Zenaida penicillata*: sex, ♂; wing, 157; tail, 110; culmen, 16; Paris Mus.

" type: sex, (♂); wing, 155; tail, 110; culmen, 16; Paris Mus.

²The central tail-feathers are slightly more pointed than those of *Zenaida a. auriculata*.

Zenaida auriculata hypoleuca Bonaparte

Zenaida hypoleuca BONAPARTE, 1854, 'Consp. Av.,' II, p. 83 ("Pearl Island"; errore; = Guayaquil, western Ecuador).

Zenaida auriculata pallens BANGS AND NOBLE, 1918, The Auk, XXXV, p. 446 (Huancabamba, N. E. Peru).

SUBSPECIFIC CHARACTERS.—Slightly smaller than *Zenaida auriculata*, with forehead, sides of head, and breast paler, the vinaceous color of neck and breast much lighter and more pinkish; flanks, axillaries, and under wing-coverts paler gray; abdomen, crissum, and under tail-coverts much paler buff, only slightly tinged with vinaceous, producing an almost whitish color. Upperparts slightly paler gray-olive instead of brown-olive.

RANGE.—From Ecuador down to Huánuco, Peru.

Measurements

				EXPOSED			
				SEX	WING	TAIL	CULMEN
							COLL.
							MUS.
Peru: Prov. Lima, Huacho,	♂	ad.	147	105	15.5	Watkins	A.M.N.H.
" " " "	♂	"	147	103	16	"	"
" " " Huaral	♂	"	148	97	15	"	"
" " " "	♂	"	155	111	15	"	"
" " " "	♂	"	147	101	14	"	"
" " " "	♂	"	146	101	14.5	"	"
" " " Sayana	♂	"	147	98	14.5	"	"
" " " Vitarte	♂	"	146	96	14	"	"
" " " "	♂	"	148	97	15	"	"
" " " La Libertad,							
Poroto	♂	"	142.5	100	1	"	"
Ecuador: Isla de Puna	♂	"	145	102	15	Richardson	"
" Celica, Prov. de Loja	♂	"	141	99	16	"	"
" Bestion, Prov. del							
Azuay	♂	"	143.5	95	15	"	"
" " " "	♂	"	146	106.5	16	"	"
" Santa Elena, Prov.							
de Guayas	♂	"	144	1	1	Gill	"
" Valle de Cumbaza,							
Mt. Chimborazo	♂	"	146	1	1	Richardson	"
" Rio Bindo, Prov. del							
Oro	♂	"	143	98	15	"	"

¹Broken.

AMERICAN MUSEUM NOVITATES

Number 649

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

July 25, 1933

56.81,9 T (117:78.6)

A GIGANTIC CERATOPSIAN DINOSAUR, *TRICERATOPS* *MAXIMUS*, NEW SPECIES

BY BARNUM BROWN

A series of eight vertebrae and two ribs, in the American Museum collection from the Hell Creek Beds of Montana, represent the largest individual of the horned dinosaurs so far recorded from the Cretaceous deposits of America.

This specimen is unique not only on account of its enormous size but also in the character and proportions of the vertebrae which distinguish it as a new species.

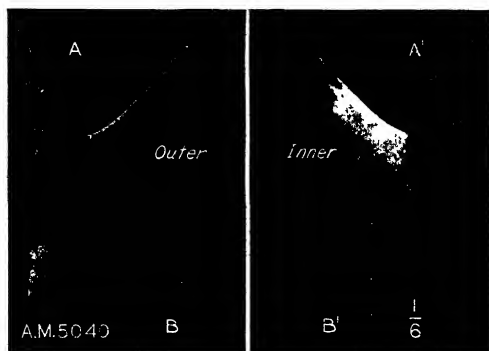


Fig. 1.—*Triceratops maximus*, Amer. Mus. No. 5040. Ribs of fused cervical section. One-sixth natural size. A. Third vertebral rib of left side, outer surface. B. Axis rib of right side, outer surface. A¹. Third vertebral rib of left side, inner surface. B¹. Axis rib of right side, inner surface.

More characteristic parts of the skeleton, when discovered, may show that this species belongs to another genus, but until adequate material is secured it is referred to *Triceratops*.

The specimen was found by Mr. P. C. Kaisen in 1909 in the basal sandstones of the Hell Creek Beds near a spring on Rock Creek, where seven vertebrae were lying in sequence, the eighth, probably the fifth (?) dorsal, being removed to some distance. Cattle had trampled the

specimen for years, completely destroying all other parts that had originally been fossilized.

It is, of course, wild speculation to attempt an estimate of the size of the skeleton from such meager remains because we know little of individual variation, sexual differences or proportional variations among different genera of the Ceratopsia.

In the Lance and the Hell Creek beds, which are practically contemporaneous in age, fossils preserved in clay are invariably distorted to such degree that they are rarely presentable as exhibition material or reliable for determining specific characters. In consequence such specimens are rarely collected.

During ten seasons of field work in these strata I personally have examined not less than five hundred Ceratopsian skulls and partial skeletons of such character, but none of them in size approached this record specimen—hence in all probability its size cannot be attributed to sex.

***Triceratops maximus*, new species**

TYPE OF SPECIES.—A. M. No. 5040, eight free vertebrae and two ribs from anterior fused cervical section.

HORIZON AND LOCALITY.—Hell Creek Beds. Rock Creek, twenty miles south of Lismas, Garfield County, Montana.

SPECIFIC CHARACTERS.—Axis rib reduced in size. Third cervical rib massive. Centra of free cervical vertebrae short, vertical and transverse diameters of articular faces nearly equal; sides deeply constricted; ventral surface flat. Anterior dorsal centra higher than broad.

The proportions of the preserved vertebrae indicate an animal having a short powerful neck and a large skull, as the free cervicals point to a fused anterior series larger than in *T. prorsus*.

The ribs are incomplete but comparison with *T. brevicornus* type leaves little doubt that we are dealing with the axis rib on the right side and the third vertebral rib on the left side. Missing sections have been introduced according to the ratios between *T. brevicornus* and *T. maximus*.

The axis rib is Y-shaped and rather delicate, with the tubercular part slightly longer than the capitular end, which is continuous with the shaft. It terminates in a short thin flat blade.

The third vertebral rib is strikingly different in form and size. It is extremely massive for a cervical rib. Evidently not more than two or three inches are missing from the distal end. Its tubercular portion rises as a thin flat blade terminating in a head set oblique to the shaft. The capitular head is massive and articulates with the centrum at an oblique

angle, almost at right angles to the tubercular head, and but slightly set apart from the shaft.

The five free cervical centra are extremely short for their breadth and all are characterized by deeply excavated sides with flat, very rugose, ventral surfaces. The anterior faces are plane, and posterior faces slightly concave with wide beveled borders indicating a thick cartilage

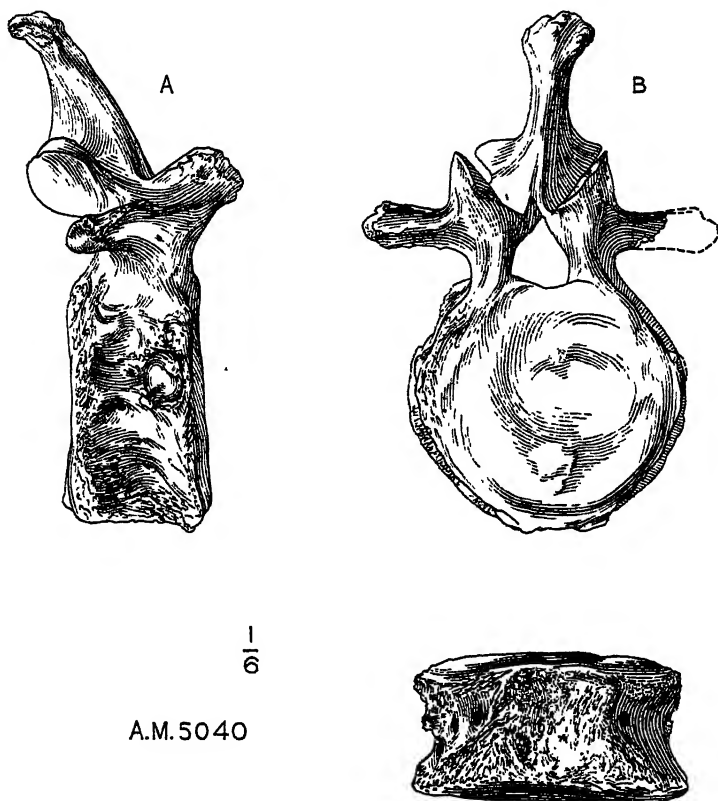


Fig. 2.—*Triceratops maximus*, Amer. Mus. No. 5040. First free cervical vertebra. One-sixth natural size. A. right side. B. Anterior view. C. Ventral view. }

union. The neural canal is extremely large. The spines, zygapophyses, and transverse processes, where preserved are proportionate to the centra, but show no characters to distinguish them from the same vertebrae in other species aside from the extraordinary size. The facets for the capitular heads of the ribs rise gradually from the middle of the centra,

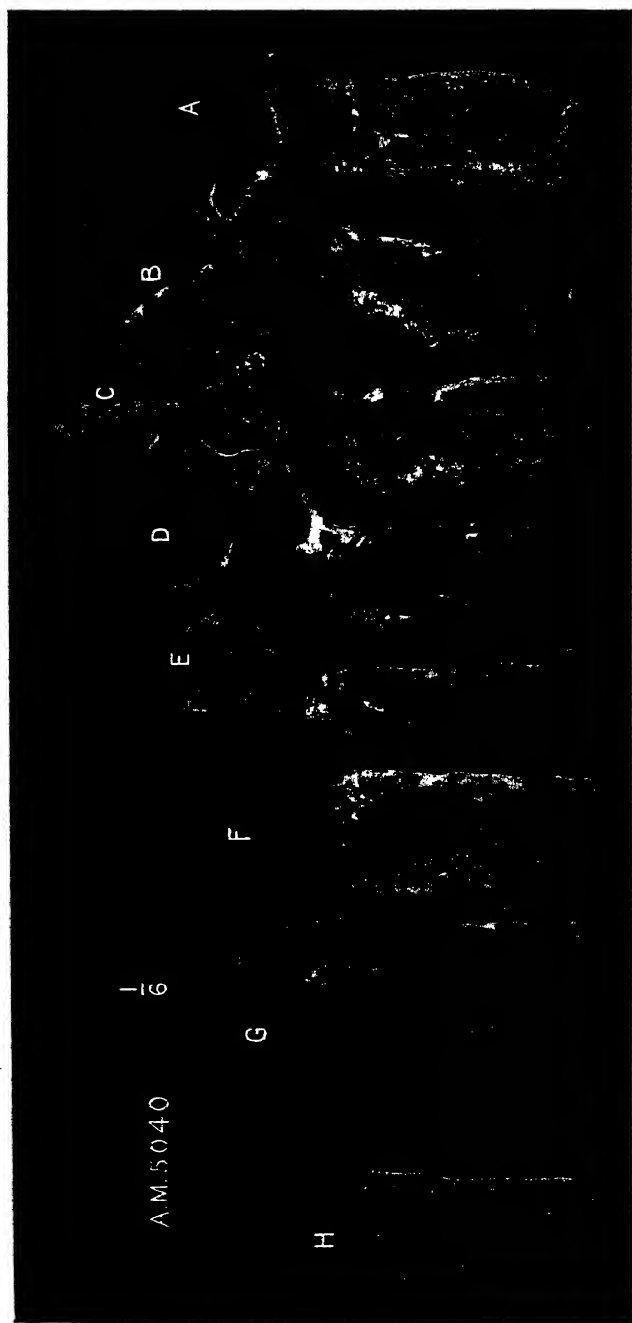


Fig. 3.—*Tricerclops mazimus*, Amer. Mus. No. 5040. Cervical and dorsal vertebrae, right side. One-sixth natural size. A. Fourth cervical. F and G. Fourth and second dorsals. H. Fifth (?) dorsal.

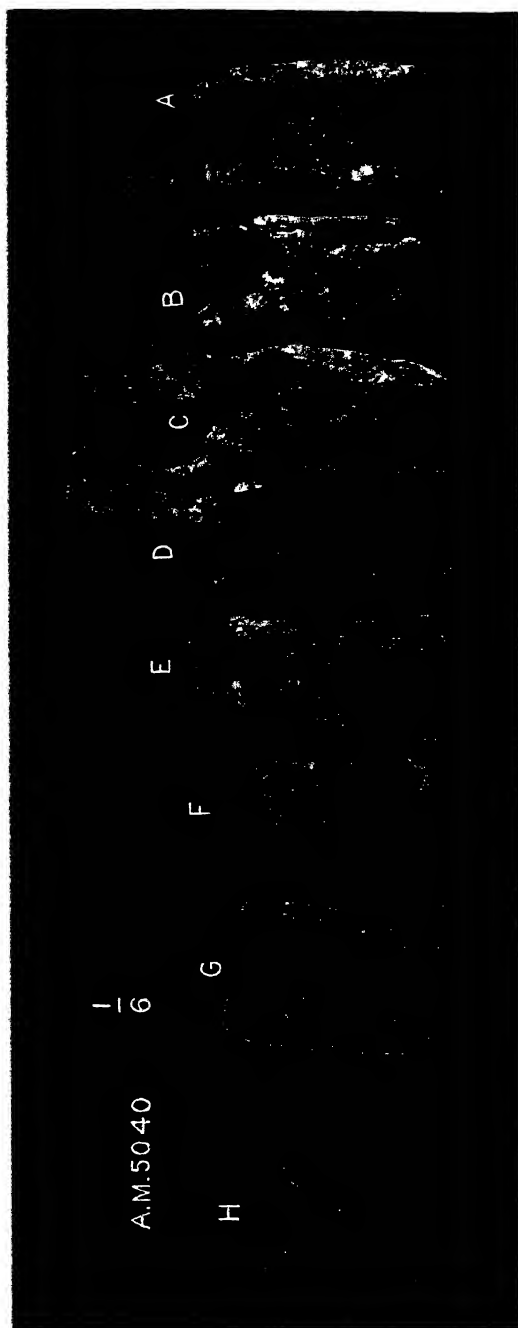


Fig. 4.—*Triceratops maximus*, Amer. Mus. No. 5040. Cervical and dorsal vertebrae, ventral view. One-sixth natural size.

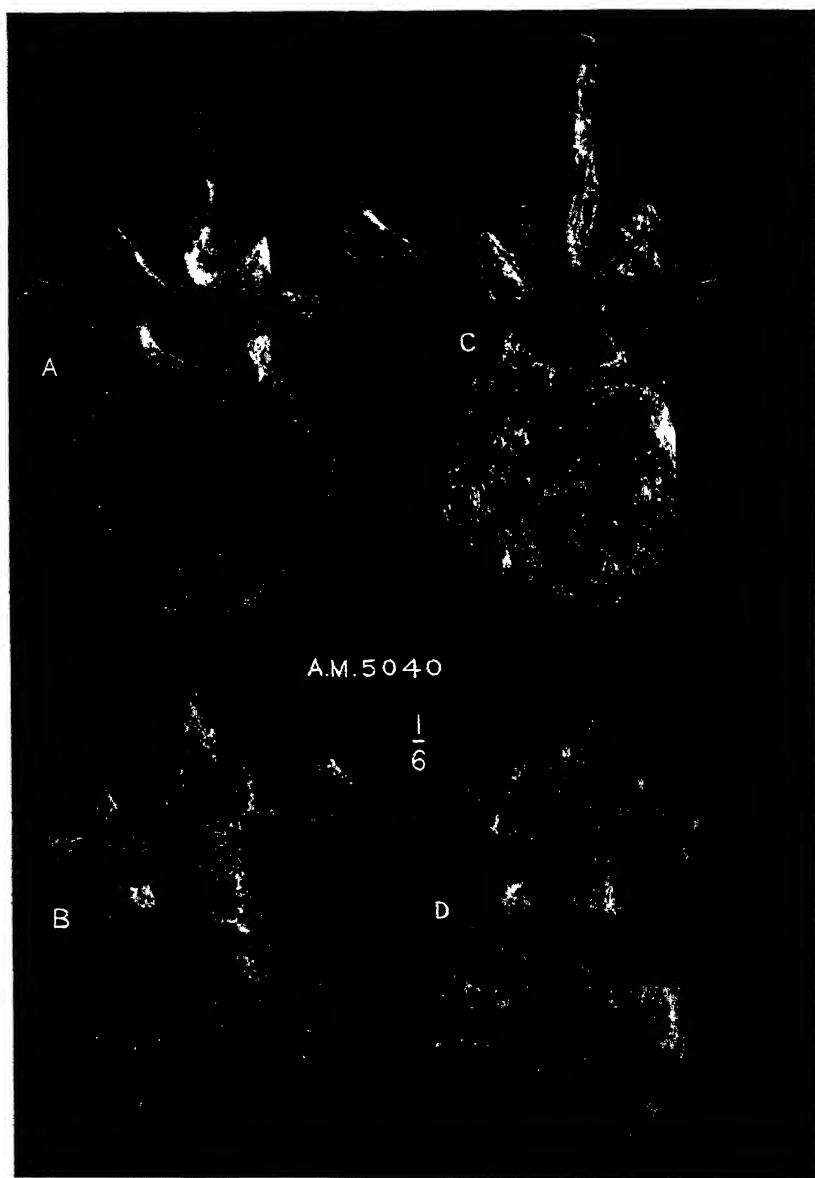


Fig. 5.—*Triceratops maxims*, Amer. Mus. No. 5040. Cervical vertebrae, anterior view. One-sixth natural size.

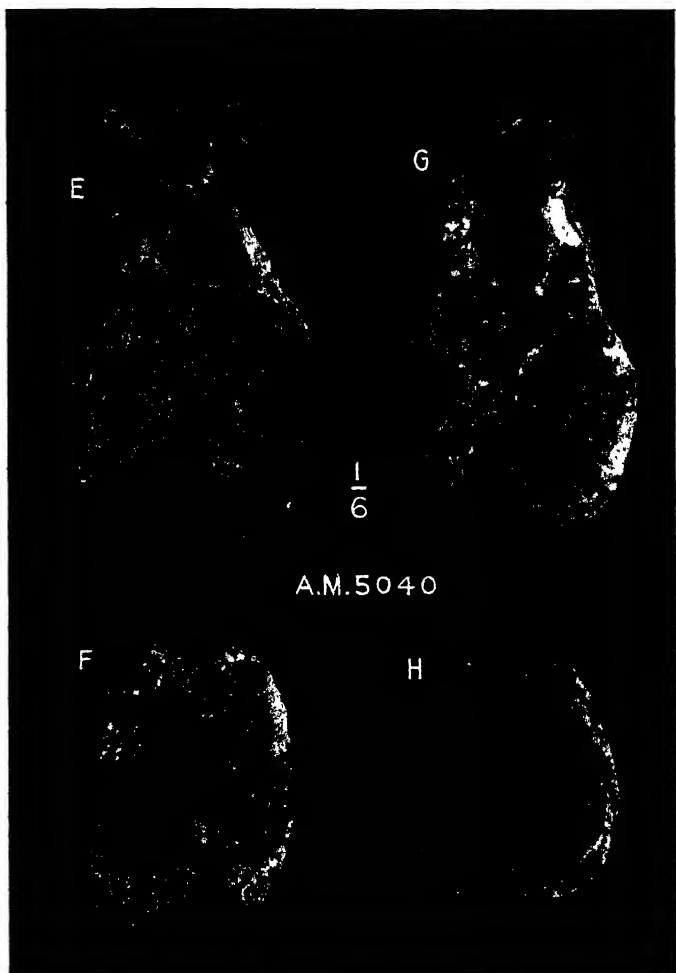


Fig. 6.—*Triceratops maximus*, Amer. Mus. No. 5040. Cervical and dorsal vertebrae, anterior view. One-sixth natural size.

near the anterior end, on the first which is the fourth cervical vertebra, to the eighth where it is located opposite the base of the neural canal.

Another prominent character in each of the cervical vertebrae is a vertical series of three large foramina on each side of the centra, spaced approximately one inch apart.

The centra of the dorsals are somewhat longer than the cervical series, and the fifth dorsal is considerably higher than it is broad, a character that is common in all other species of this genus, but the centra are relatively longer than they are in *T. brevicornus* and *T. calicornis*.

MEASUREMENTS

First free cervical vertebra:

Length of centrum at base.....	120 mm.
Vertical diameter, anterior face.....	193 mm.
Transverse diameter, anterior face.....	219 mm.
Vertical diameter, posterior face.....	184 mm.?
Transverse diameter, posterior face.....	225 mm.?
Height of spine above base of neural canal.....	234 mm.
Length of transverse process from center of spine.....	150 mm.

Second free cervical vertebra:

Length of centrum at base (face exfoliated).....	107 mm.
Vertical diameter, anterior face.....	183 mm.
Transverse diameter, anterior face.....	216 mm.
Vertical diameter, posterior face (crushed).....	194 mm.
Transverse diameter, posterior face.....	210 mm.

Third free cervical vertebra:

Length of centrum at base.....	118 mm.
Vertical diameter, anterior face.....	200 mm.
Transverse diameter, anterior face.....	196 mm.
Vertical diameter, posterior face.....	193 mm.
Transverse diameter, posterior face.....	212 mm.
Height of spine above base of neural canal.....	277 mm.
Length of transverse process to middle spine.....	203 mm.

Fourth free cervical vertebra:

Length of centrum at base.....	103 mm.
Vertical diameter, anterior face.....	191 mm.
Transverse diameter, anterior face.....	215 mm.
Vertical diameter, posterior face.....	206 mm.
Transverse diameter, posterior face.....	205 mm.
Length of transverse process to middle of spine.....	200 mm.

Fifth free cervical vertebra:

Length of centrum at base.....	104 mm.
Vertical diameter, anterior face.....	209 mm.
Transverse diameter, anterior face.....	215 mm.
Vertical diameter, posterior face.....	195 mm.
Transverse diameter, posterior face.....	205 mm.

First dorsal vertebra (slightly crushed):

Length of centrum at base.....	120 mm.
Vertical diameter, anterior face.....	207 mm.
Transverse diameter, anterior face.....	184 mm.
Vertical diameter, posterior face.....	203 mm.
Transverse diameter, posterior face.....	190 mm.

Second dorsal vertebra (slightly crushed):

Length of centrum at base.....	128 mm.
Vertical diameter, anterior face.....	177 mm.
Transverse diameter, anterior face.....	170 mm.
Vertical diameter, posterior face.....	194 mm.
Transverse diameter, posterior face.....	191 mm.

Fifth (?) dorsal vertebra:

Length of centrum at base.....	110 mm.
Vertical diameter, anterior face.....	189 mm.
Transverse diameter, anterior face.....	158 mm.
Vertical diameter, posterior face.....	182 mm.
Transverse diameter, posterior face.....	155 mm.

TWO *STELIS* (*ODONTOSTELIS*) AND A *MELIPONA* BEE THAT
HAVE BEEN RECORDED IN ERROR AS ANTHIDIINAE

BY HERBERT F. SCHWARZ

Some bees of the subfamily Stelidinae which occur asinquilines in the nests of Anthidiine bees have a rather close resemblance to their hosts. The presence on the under side of the abdomen of a dense brush for collecting pollen grains characterizes, however, the females of the Anthidiinae; in contrast, the females of the Stelidinae, which lay their eggs on the provisions gathered by their hosts, lack this equipment for an industrious life or have it poorly developed. There is, therefore, little difficulty as a rule in separating the females of the Anthidiinae from the females of the Stelidinae, although even in this sex the distinction is sometimes hard to establish. The males, on the other hand, are not so readily differentiated, with the result that some species that were originally described from the male have been assigned to the wrong group.

Although the Anthidiinae are easily separated structurally in both sexes from the Meliponidae, nevertheless some *Melipona* are superficially rather like the Anthidiinae, one *Melipona* having even been given the specific name *anthidioides*. What I believe to be a misinterpretation of Packard (referred to at the close of this paper) rests, it would seem, on the convincing character of these superficial resemblances.

***Stelis* (*Odontostelis*) *bivittatum* (Cresson)**

Anthidium bivittatum CRESSON, 1878, Trans. Amer. Entom. Soc., VII, pp. 116-117. FRIESE, 1911, 'Das Tierreich,' Lieferung 28, pp. 391, 394.

Dianthidium bivittatum COCKERELL, 1912, Entomological News, XXIII, p. 445; 1913, Annals and Magazine of Natural History, (8) XII, p. 108; 1914, Proc. U. S. Nat. Mus., XLVII, p. 91.

Stelis abnormis FRIESE, 1925, Stettiner Entomologische Zeitung, LXXXVI, Heft 2, pp. 35-36.

Stelis (*Odontostelis*) *abnormis* COCKERELL, 1931, Annals and Magazine of Natural History, (10) VIII, pp. 541-542.

In my estimation *bivittatum*, described by Cresson (1878) as an *Anthidium*, is the same insect as that described by Friese (1925) under the name *Stelis abnormis*. I have had opportunity to examine Cresson's type of *bivittatum* and I have likewise had access to specimens—a male

and a female—identified by Friese as *abnormis*. The specimens from Friese were secured at San José, Costa Rica, which is the type locality of *abnormis*, and the collector, Schmidt, is the very individual from whom Friese received his type material, but the specimens do not bear a type label. The date associated with the female is unfortunately slightly effaced, but seems to read "5. 25." The notation "*ex Euglossa*" on the label of the male suggests that the specimen was one of those to which Friese alluded (1925) as having emerged from a nest of *Euglossa viridissima*. The date recorded on the label is July 10, 1923,—probably the date of emergence.

It seems to me not unlikely that what Cockerell described as the female of *Dianthidium bivittatum* in 1913 is also the same insect as that referred to in 1931 as *Stelis abnormis*. It is true that in Cockerell's description of the female of *bivittatum* the inner edge of the mandibles is said to be quadridentate whereas the female of *abnormis* is described by Friese as having a quinquedentate inner edge. The female in the American Museum collection that was identified by Friese as *abnormis* actually has, however, a four-toothed mandible but the innermost tooth is faintly bidentate and, if this condition were more pronounced (and this may have been the case in Friese's type), the term quinquedentate would apply. In another female specimen, collected at Pto. Castilla, Honduras, March 30, 1924, and loaned me by the British Museum, the mandibles are indubitably quadridentate. I think the seeming discrepancy in the descriptions is probably ascribable to slight variability in this structural character.

Cresson in describing the male of *bivittatum* indicated that the yellow band encircling the head posteriorly is sometimes interrupted, and this variability occurs also in the female of *bivittatum*. Maculations like the upwardly divergent stripes between the antennae (corresponding more or less to the carinae in this area) and the stripes on the under side of the middle femora,¹ mentioned in Cockerell's description (1913) of the female of *bivittatum* but omitted from Friese's description (1925) of *abnormis*, nevertheless are present in the female identified by Friese as *abnormis*.

Of significance is the fact that the female of *bivittatum* has, according to Cockerell (1913), "ventral scopa thin and short," which is the condition in Friese's specimen of *abnormis*.

In general, except for the usual sexual differences, the male and female of *bivittatum* are structurally rather similar. Both sexes have

¹Cresson's statement in the description of the male that the tibiae are striped beneath would seem to be a slip of the pen when he intended to say femora.

carinae between the antennae that diverge above; both have large, coarse punctation on the scutellum, contrasted with the much finer punctation of the tergites of the abdomen; and in both the basal margin of the metathorax is strongly pitted and the enclosure polished or barely tessellate, with a few punctures on each side near the top.

What strikingly differentiates the female from the male, however, is the presence of a large, rather triangular, black-edged, tooth-like elevation at the base of the mandible. In the male the base of the mandible is devoid of such a character. This sexual dimorphism parallels that described by Friese in the case of the South American species, *portoi*, which both structurally and in its maculations is very close to *bivittatum*.

Cresson's *bivittatum* was described from Mexico, and its range extends at least to the Canal Zone, from which there is in the American Museum a male specimen collected by T. Hallinan at Balboa, June 11-14, and a female specimen from Barro Colorado collected by F. E. Lutz, March 21, 1933.

An insect to which the male, at least, of *bivittatum* is structurally rather similar is *Dianthidium* (*Anthodiocetes*) *calcaratum* (Friese), originally described as a *Stelis*. Although a smaller insect, *calcaratum* has, however, much stronger and larger punctation on the head, and particularly on the mesonotum and pleura, than has *bivittatum*, its forewings are darkened along the anterior margin (not orange colored to ferruginous except for the apical tip as in *bivittatum*), the hairs on the sternites of the male are white, short, and undifferentiated (in the male of *bivittatum* the hairs on the sternites are a little longer and on the apex of sternite 3 there is a fringe of very long yellowish hairs that are incurved).

There is before me a series of *calcaratum* from S. José, including a male and a female collected by H. Schmidt on "5.25."

It would seem probable that *bivittatum*, which is in many of its characters much like *calcaratum* and may even be derived from it, is an inquiline in nests of *calcaratum* as well as in those of the *Euglossa* mentioned by Friese. It is to be noted, in this connection, that as to place, collector, and date, some of the specimens of *calcaratum* and of *bivittatum* are in accord.

Stelis (*Odontostelis*) *portoi* (Friese)

Anthidium portoi FRIESE, 1910, Deutsche Entomologische Zeitschrift, p. 694. DUCKE, 1908, Revue d'Entomologie, Caen, XXVII, p. 77.

Dianthidium (*Anthodiocetes*) *portoi* COCKERELL, 1927, Proceedings of U. S. Nat. Museum, LXXI, Art. 12, p. 2 (tentatively included in a "Key to Species belonging to, or resembling, *Anthodiocetes*").

A female specimen of what I believe to be *portoi* has been loaned by the British Museum. It was collected by W. M. Wheeler at Kartabo, 1920, and extends the known range of *portoi* from Brazil into British Guiana. In this specimen of *portoi* the stout tooth-like elevation at the base of the mandibles of the female is more pronounced even than in *bivittatum* and the apical two-thirds of the mandible is more slender and sickle-like than in *bivittatum*. As in *bivittatum*, there are four teeth along the receding apex of the mandible, the fourth tooth, widely separated from the other three, constituting the inner angle of the mandible. In another structural character the females of *bivittatum* and *portoi* are rather different. Friese describes the clypeus of the female of *portoi* as "broad, blunt, prolonged at the middle into a small spine," and this is the condition also in the specimen from Kartabo. In sharp contrast the similarly broad clypeus of the female of *bivittatum* has toward the middle of the apex two slightly diverging, stubby spines separated from each other at the base by about the length of one of them. The clypeus of the female of *portoi* is partly yellow, that of the female of *bivittatum* black, but in other respects their maculations agree rather closely, even to the presence of pale stripes on the under side of the femora in *bivittatum* and in the Kartabo specimen of *portoi* (not mentioned in Friese's description of *portoi* and possibly not shared therefore by Brazilian representatives of *portoi*). The conspicuous stripes on the dorsum of the thorax are shared by both sexes of *bivittatum* and *portoi*.

If *bivittatum* is to be considered a *Stelis* (and the observations of Friese on its inquiline habits would seem to sustain its allocation to that genus), then *portoi*, so similar in many respects to *bivittatum*, is also to be considered a *Stelis*. Indeed Friese (1910) noted in connection with the description of the male of *portoi*: "Sternites 3-5 depressed, as in *Stelis*." Although Friese does not allude to the scanty development of the ventral scopa of the female, the specimen of *portoi* from Kartabo presents a condition to which the description of the female of *bivittatum* could well be applied: "ventral scopa thin and short."

The females of both *bivittatum* and *portoi* have antennae very like those of the male of at least *bivittatum*, the third joint being very small, comparable in length to the narrower second joint.

***Melipona interrupta* subspecies *grandis* Guérin**

Melipona grandis GUÉRIN, 1844¹(?), 'Iconogr. du Règne animal de G. Cuvier,' III, p. 463. SMITH, 1854, 'Catal. Hymenoptera British Mus.,' part 2, p. 405. DALLA TORRE, 1896, 'Catalogus Hymenopterorum,' X, p. 579.

Anthidium pictifrons PACKARD, 1869, 1st Rep. Peabody Acad. Sci., p. 59.
FRIESE, 1911, 'Das Tierreich,' Lieferung 28, pp. 392, 399.

Melipona interrupta aequatorialis SCHULZ, 1903, Sitzungsbericht Math. Phys. Klasse der K. B. Akad. der Wissens., München, (pub. 1904), XXXIII, pp. 815-816.

Melipona interrupta subspecies *grandis* DUCKE, 1910, Deutsch. Ent. Zeitschr., p. 367; 1916, 'Enumeração dos Hymenopteros collegidos pela Comissão e Revisão das Especies de Abelhas do Brasil,' p. 163; 1925, Zool. Jahrb. System. Geogr. u. Biol., XLIX, pp. 440-441. SCHWARZ, 1932, Bull. Amer. Mus. Nat. Hist., LXIII, Art. 4, pp. 286, 290, 293, 298, 304, 305-307.

I strongly suspect that what Packard described as *Anthidium pictifrons* is no other than *Melipona interrupta* subspecies *grandis*. Such elements in the description as "but one subcostal cell, and that faintly marked on the outer side" and "hind tibiae broad, convex, polished black, with a slight fringe of white hairs" and "a long curved brush of bristles at the tibiotarsal joint," are all suggestive of *Melipona* but seem definitely to alienate the specimen from *Anthidium*. The details of the description of *pictifrons* fit *Melipona interrupta* subspecies *grandis* almost perfectly.

Friese, 1911, had expressed strong doubt whether Packard's insect could be assigned to *Anthidium*.

AMERICAN MUSEUM NOVITATES

Number 651

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Aug. 14, 1933

59.88, 1 M (8)

BIRDS COLLECTED DURING THE WHITNEY SOUTH SEA EXPEDITION. XXV¹

NOTES ON THE GENERA *MYIAGRA* AND *MASTERSORNIS*

BY ERNST MAYR

The present paper contains a continuation of the revisions of Polynesian genera. The rich material in the genus *Myiagra* has given me the welcome opportunity to discuss also the correlation between molt, breeding time and season in Polynesia (pp. 12, 14).

MYIAGRA Vigors and Horsfield

Myiagra VIGORS AND HORSFIELD, 1827, Trans. Linn. Soc. London, XV, p. 250.

Type (by subsequent designation, Gray, 1840, p. 23): *M. rubeculoides* = *Todus rubecula* Latham.

Submyiagra MATHEWS, 1913, Austral Av. Rec., II, p. 61, new name for

Platygathus HARTLAUB, 1852, Arch. f. Naturg., p. 132. [*Nec Platygathus* Audinet-S. 1832.] Type (by subsequent designation, Sharpe, 'Cat. Birds,' IV, p. 371): *M. rufiventris* Elliot (= *Platyrhynchus vanikorensis* Peale *nec* *Platyrhynchus vanikorensis* Quoy and Gaimard).

Mastersornis MATHEWS, 1917, Austral Av. Rec., III, p. 78, new name for *Myiagra* VIGORS AND HORSFIELD, 1827, and not *Myagrus* Boie, 1826.

Lophomyiagra MATHEWS, 1928, Nov. Zool., XXXIV, p. 373. Type (by original designation): *M. azureocapilla* Layard.

This genus, which is easily recognizable by its broad bill and the color pattern which is similar in all species, reaches from Australia southward to Tasmania, westward to Timor, Djampea, and the Moluccas, northward to Micronesia (Palau, Marianne, and Caroline Islands), and eastward to Central Polynesia. It is absent, however, from the greater part of New Guinea, where it occurs only along the southern coast. Mathews lists not less than seventeen species in the 'Systema Avium Australasianarum,' pp. 500-506. Many of these have, however, only subspecific rank, and others obviously represent each other (super-species), although they may be called species for the present.

In structure and general color pattern all these forms are rather similar. The width of the bill is not uniform and is in some cases considerably less than in the typical species. This is particularly true for

¹Previous papers in this series comprise American Museum Novitates, Nos. 115, 124, 149, 322, 337, 350, 356, 364, 365, 370, 419, 469, 486, 488, 489, 502, 504, 516, 520, 522, 531, 590, 609, and 628.

the western subspecies of *M. ferrocyanea*. The only species which differs somewhat from the other members of the genus is *M. azureocapilla* Layard. Mathews has created the new genus *Lophomyiagra* for this species, which I do not consider worth recognizing as a full genus. In the female plumage this species is quite similar to the other species of the genus *Myiagra*.

About 500 specimens from sixty islands representing four species with several subspecies were studied and measured during the preparation of the present paper.

SUPERSPECIES *Myiagra rubecula*

In my paper on the birds of Rennell Island¹ I proposed to regard all the broadbills of Polynesia [with the exception of *azureocapilla*] as members of one species which represented *M. rubecula* of Australia and *M. ferrocyanea* of the Solomon Islands, an arrangement which is certainly acceptable. However, a renewed and more extensive study of the group has convinced me that it is perhaps more correct to keep *caledonica* Bonaparte and *albigentris* Peale specifically distinct from *vanikorensis* Quoy and Gaimard. To indicate the close relation and the geographical representation; I include all these species in one superspecies. Further revisions will be necessary to find out how far to the west and north of Australia this superspecies extends.

Myiagra caledonica

RANGE.—New Caledonia, Loyalty Islands, New Hebrides, Banks Islands, Torres Islands, and Rennell Island.

Only two of the five recognized forms of this species are represented in the Whitney collection. In view of the unsatisfactory treatment, however, which this group received from Mathews in the 'Systema Avium Australasianarum,' I will give a short review of all the forms, although this already has been done in an excellent way by F. Sarasin.² The two new forms described by Sarasin in the same paper are rather doubtful. He saw two adult males from Maré, and only one adult male from each of the other islands. Judging from the descriptions, as I have not examined any material from the Loyalty Islands, the subspecies from Maré seems to be tenable, the one from Uvea, however, invalid. The range of individual variation on one island is far greater than the slight difference indicated by Sarasin in figures 12 and 13 on Taf. II (*op. cit.*).

¹1931, Amer. Mus. Novit., No. 486, p. 24.

²1913, 'Die Vögel Neu-Caledoniens und der Loyalty-Inseln,' pp. 22-26.

***Myiagra caledonica caledonica* Bonaparte**

Myiagra caledonica BONAPARTE, 1857, Rev. et Mag. de Zool., p. 53, New Caledonia [description of male and female].

Myiagra perspicillata G. R. GRAY, 1859, Proc. Zool. Soc. London, p. 162, Nu Island, New Caledonia [description of juvenal male].

RANGE.—New Caledonia.

***Myiagra caledonica viridinitens* Gray**

Myiagra viridinitens G. R. GRAY, 1859, Proc. Zool. Soc. London, p. 162, Lifu, Loyalty Islands [description of adult male].

Myiagra luguieri TRISTRAM, 1879, Ibis, p. 188, Lifu, Loyalty Islands [description of adult male].

Myiagra intermedia TRISTRAM, 1879, Ibis, p. 189, Lifu, Loyalty Islands [description of female].

Myiagra caledonica uveaensis F. SARASIN, 1913, 'Die Vögel Neu-Caledoniens und der Loyalty-Inseln,' p. 25, Ouvéa, Loyalty Islands.

RANGE.—Lifu and Uvea, Loyalty Islands.

***Myiagra caledonica mareensis* Sarasin**

Myiagra caledonica mareensis F. SARASIN, 1913, *loc. cit.*, Maré, Loyalty Islands.

RANGE.—Maré, Loyalty Islands.

***Myiagra caledonica melanura* Gray**

Myiagra melanura G. R. GRAY, 1860, 'Cat. Birds Trop. Isl. Pac.,' 1859, p. 18 Erromango, New Hebrides [description of adult male].

Myiagra tannaensis TRISTRAM, 1879, Ibis, p. 192, Tanna, New Hebrides [description of female].

ADULT MALE.—Head and throat glossy greenish black; back lighter and more grayish; wings and tail blackish with glossy green edges; tips of tail-feathers either entirely black or with narrow white edges; abdomen, flanks and under tail-coverts white.

ADULT FEMALE.—Crown, hind neck and sides of neck gray with a greenish gloss; back-olive brown, rump more grayish; chin, throat, and upper breast ochraceous orange to tawny; lower breast, abdomen, and under tail-coverts whitish; wing-feathers and tail-feathers brownish, edges of wing-coverts and secondaries cinnamon or buffy.

IMMATURE.—Similar to adult female, but bill horn-colored and with whitish base, not black; throat and breast paler, belly distinctly washed with buff; tips on wing-coverts, secondaries and tail-feathers broader and more whitish.

Culmen, 21; tarsus, 18 mm. (in adult males).

ADULT MALES

	WING	TAIL
Efate	76-81 (78.2)	62-70 (65.2)
Epi and Mai	78-81 (79.2)	64-67 (65.8)
Santo	77-80 (78.6)	65-67 (66.5)
Malekula	76-80 (78.1)	65-68 (66.3)
Banks Is.	77-81 (79.4)	64-70 (67.5)
Sou, Torres Is.	77	64

These figures show that there is no geographical variation of size. I therefore combine the figures of the females from the different islands:

ADULT FEMALES	
WING	TAIL
74-77 (75.7)	62-64 (62.9)

RANGE.—New Hebrides (Aneiteum, Tanna, Erromango, Efate, Nguna, Mau, Mataso, Mai, Tongoa, Epi, Aoba, Pentecost, Aurora, Malekula, Malo, Dolphin, Santo), Banks Islands (Gaua, Vanua Lava, Valua, Bligh), and Torres Islands (Sou).

There are no essential differences between the birds from the various islands. Males from the Banks Islands and northern New Hebrides on the average have the glossy parts more greenish. There is much irregularity in this character, however. Females show a great deal of individual variation, which affects the amount of metallic gloss on the gray crown, the shade of ochraceous tawny on the throat and of the ocher on the wing-coverts, the width of the whitish edge of the outer tail-feathers, and the color of the back. However, there are no geographical tendencies expressed in this variation.

The single specimen from the Torres Islands differs somewhat from typical birds by having a more bluish gloss and the bill rather narrow. More material is necessary to decide whether or not these characters are constant.

***Myiagra caledonica occidentalis* MAYR**

Myiagra vanikorensis occidentalis MAYR, 1931, Amer. Mus. Novit., No. 486, p. 24, Rennell Island.

RANGE.—Rennell Island.

Particulars about this subspecies are given in the original description.

Myiagra vanikorensis

RANGE.—Santa Cruz and Fiji Islands.

***Myiagra vanikorensis vanikorensis* (Quoy and Gaimard)**

Platyrrhynchos vanikorensis QUOY AND GAIMARD, 1830, 'Voy. "Astrol."' Zool. I, p. 183 (Pl. v, fig. 1), Vanikoro, Santa Cruz.

ADULT MALE.—Crown, sides of head, and throat glossy bluish black; rest of upperside dark gray, with some bluish gloss, particularly on upper back and upper tail-coverts; wing-feathers and tail-feathers black with glossy bluish edges, especially on the upper wing-coverts; tips of outer tail-feathers sometimes with whitish or buffy edges, sometimes pure black; lower breast tawny, abdomen, flanks, and under tail-coverts paler; axillaries gray with buff tips, under wing-coverts blackish with a few buff tips, thighs blackish, and inner edges of wing-feathers whitish.

ADULT FEMALE.—Crown and sides of head gray with an indistinct bluish gloss, lighter on forehead and lores; back, scapulars, and rump olivaceous gray; wing-feathers and tail-feathers brownish; wing-coverts with ochraceous edges, secondaries with buffy edges; entire underside ochraceous orange to ochraceous buff, chin, lower abdomen, and under tail-coverts lighter; tail-feathers, at least outer ones, with narrow white edges.

IMMATURE.—Similar to adult female, but wing-feathers more rounded, tail-feathers pointed; lower mandible brownish, not black; wing-coverts and secondaries with whitish edges, white tips on tail-feathers broader; entire underside lighter.

Culmen, 17-18; tarsus, 16-17 (in adult males).

	WING	TAIL
9 ♂ ad.	66-68 (66.9)	54-57 (55.7)
6 ♀ ad.	65-67 (65.5)	53-56 (54.2)

RANGE.—Vanikoro Island, Santa Cruz Islands.

These are apparently the only specimens known besides the type. The locality Vanikoro Island, assigned by Quoy and Gaimard to their new species, has often been questioned during the past hundred years. The rediscovery of this species by the Whitney Expedition definitely proved the correctness of the type locality indicated by the original describers, although the measurements alone given by Quoy and Gaimard furnish evidence enough that their specimen did not come from Fiji.

Myiagra vanikorensis rufiventris Elliot¹

Myiagra rufiventris ELLIOT, 1859, Ibis, p. 393, "Samoan or Navigator's Islands," by error, hereby restricted to Viti Levu, Fiji Islands.

SUBSPECIFIC CHARACTERS.—Male: of small size and with small bill; abdomen light; under tail-coverts mostly whitish; tibial feathers whitish; bluish zone of throat usually sharply defined against the breast and not reaching very low; secondaries with light edges; upper tail-coverts frequently with light edges, at least not with bluish glossy edges; wing-bend (lesser under wing-coverts) with broad whitish edges; back grayish. Female: small; back (in fresh specimens), almost pure gray; upper tail-coverts with broad whitish edges; edges of greater wing-coverts and of secondaries whitish, not buffy; lores and feathers of forehead light (whitish gray); under parts light; throat mostly whitish; under tail-coverts whitish or ochraceous buff.

ADULT MALE.—Head and throat glossy greenish black; rest of upperside grayish with a faint gloss; breast and abdomen ochraceous buff, richer on the breast.

ADULT FEMALE.—Crown and sides of head dark gray with a greenish-blue gloss; rest of upperside light neutral gray; chin and upper throat whitish; lower throat, breast and belly pale ochraceous.

IMMATURE MALE.—Similar to the adult female, but bill not black but dark brown, with a whitish base; lores darker, crown and ear-coverts much more glossy, light edges on secondaries wider; broad whitish or buffy tips on greater wing-coverts;

¹The name *Myiagra castaneiventris* Finsch and Hartlaub, 1887, 'Reitr. Faun. Centr. Polynes.,' p. 95, cannot be applied to this form on account of article 31 of the 'International Rules of Zool. Nomenclature,' being based on a misidentification of *Monarcha castaneiventris* Verreaux.

primaries more rounded, and tail-feathers more pointed; underside frequently much richer ochraceous.

Some of the immature males wear a "progressive plumage": that is, a plumage somewhat intermediate between the immature and the adult plumage. These birds have more or less the typical immature plumage, but in the region of the throat have some feathers which are either glossy black or half whitish and half blackish. I originally thought that these were the first feathers of the adult plumage just appearing in the molt, but closer examination convinced me that they belong to the same generation of feathers as the other immature plumes.

IMMATURE FEMALE.—Similar to the adult female, but with the usual signs of immaturity on bill, wings, and tail. Differs from the immature male by lacking the gloss on crown and ear-coverts and usually by the paler coloration of the under parts.

NESTLING.—Very different from adult. Entire underside whitish or light buff; feathers on breast with fuscous tips forming a dark breast-band. Entire upperside, sooty wing-coverts and upper tail-coverts with broad buffy tips. This entire plumage is of a silky, downy nature.

This plumage is exchanged for the immature plumage (not affecting wing- and tail-feathers nor primary-coverts nor greater wing-coverts). This molt begins with the crown and the lower throat, and ends on the under and upper tail-coverts.

The birds united by me under the name *rufiventris* Elliot do not form an entirely uniform population. We have the same problem as that encountered in many previous revisions of Polynesian genera which are distributed over a large number of islands. As in those cases I have refrained from naming all these minor deviations and content myself in outlining briefly the trends of geographical variation.

ADULT MALES

Birds from Ovalau agree practically with typical Viti Levu specimens.

MALOLO AND MALAKI (off shore of Viti Levu).—Two very worn specimens, average underneath lighter, under tail-coverts white; back rather glossy. Some of the differences may be due to wear.

NGAU.—Very light.

YASAWA ISLANDS.—Abdomen averaging slightly richer rufous; upperside apparently as in Viti Levu birds, with the same individual variation; some birds have the back more grayish, some more glossy; some have the gloss more greenish blue, some more bluish.

VIWA.—Underside still more richly tinted, practically no more overlapping.

VANTA LEVU.—Very much like Viwa birds, with the underside much richer than in Viti Levu; a great deal of individual variation.

MATHUATA AND KIO.—Identical with Vanua Levu birds.

YENDUA, YANTHA, THOMBIA.—Underside still darker, back often rather glossy.

THIKOMBIA.—In most characters definitely approaching *dorsalis*. Underside rather dark, back glossy, light edges on secondaries and upper tail-coverts reduced, bluish region of throat extended.

NAMENA, NAIRAI, MBATIKI, AND WAKAYA.—With very dark abdomen and rather glossy back, but otherwise typical *rufiventris*.

ADULT FEMALES

The females also show differences in their characters from island to island. The trends of variation do not run exactly parallel to those of the males, although Ngau females also have the lightest coloration and Koro females the darkest; the coloration of the upperside seems not to vary.

OVALAU, WAKAYA, YASAWA ISLANDS, AND VANUA LEVU.—Similar to typical Viti Levu females. Considerable individual variation.

NGAU.—Very light; entire throat white; under tail-coverts whitish; abdomen pale ochraceous buff.

VIWA.—Ochraceous tones on underside rather rich; area of white on throat restricted.

KIO, RAMBI, THOMBIA, AND THIKOMBIA.—Underneath richer than typical birds; upperside apparently somewhat darker (specimens worn!); light edges on secondaries apparently narrower; otherwise quite typical and not approaching *dorsalis* in any character.

KORO AND NAMENA.—Very rich ochraceous underneath; whitish on throat reduced to small area on chin; under tail-coverts always ochraceous buff; back less pure gray; edges of secondaries not pure white, but washed with buff.

		WING	TAIL	CULMEN
Viti Levu				
Malaki	10 ♂ ad.	70-75 (72.4)	53-58 (55.8)	17.5-18.5 (18.2)
Malolo				
Ovalau				
Viwa	5 ♂ ad.	71-75 (73.0)	54-59 (56.4)	17.5-18 (17.9)
Ngau	2 ♂ ad.	73, 76	57, 59	18, 19
Koro	8 ♂ ad.	70-75 (72.2)	55-60 (56.9)	18
Wakaya	} 6 ♂ ad.	72-75 (73.8)	58-60 (59.4)	
Mbatiki				
Nairai				
Namena				
Yendua	2 ♂ ad.	74, 75	59, 59	18, 18.5
Vanua Levu				
Mathuata				
Rambi	} 17 ♂ ad.	70-75 (72.6)	55-58 (56.0)	17-18.5 (17.8)
Kio				
Taviuni				
Yanutha	} 7 ♂ ad.	75-76 (75.2)	57-61 (59.0)	19-19.5 (19.1)
Thombia				
Thikombia	3 ♂ ad.	74-76 (75.0)	59-63 (60.6)	18.5-20 (19.3)
Total for all islands				
except the three	♂ ad.	70-76 (72.9)	53-60 (56.8)	17-19 (18.0)
last	♀ ad.	67-72	52-59	17-19

		WING	TAIL	CULMEN
Viwa	3 ♀ ad.	67-70 (69.0)	52.5, 55 (53.7)	18-19 (18.7)
Yasawa Islands	8 ♀ ad.	68-70 (69.1)	53-55 (53.7)	17.5-18.5 (18.3)
Viti Levu	}	68-70 (69.1)	53-54 (53.8)	17.5-18.5 (17.9)
Ovalau				
Namena	1 ♀ ad.	70	56.5	18
Wakaya	1 ♀ ad.	70	54.5	
Ngau	3 ♀ ad.	70, 71 (70.5)	57-59 (57.6)	17.5-18 (17.8)
Koro	5 ♀ ad.	67-72 (70.2)	54-59 (56.5)	17-19 (18.0)
Vanua Levu	}	68.5-72 (70.4)	53-56.5 (54.6)	17-18 (17.7)
Mathuata				
Kio				
Rambi				
Thombia	1 ♀ ad.	71	56	18.5
Thikombia	2 ♀ ad.	72, 72	57.5, 57.5	18, 19.5

These measurements also reveal slight variations from island to island. Birds from Ngau and Koro have rather long tails; those from Yanutha, Thombia, and particularly Thikombia, are slightly larger in all measurements.

RANGE.—Islands of northern and northwestern Fiji: Viwa, Yasawa Islands (Monuriki, Navandra, Waia, Naviti, Matathoni, Asawa ilau, Nathoulla, Yasawa), Viti Levu, Malaki, Malolo, Ngualilo, Ovalau, Wakaya, Mbatiki, Nairai, Namena, Ngau, Koro, Yendua, Mathuata, Vanua Levu, Kio, Rambi, Taviuni, Thombia, Yanutha, and Thikombia.

There has been considerable uncertainty about the name of this subspecies. Most authors used the name *vanikorensis* for the Fijian birds, considering the type locality Vanikoro as erroneous. However, as I have shown above, Vanikoro is inhabited by a perfectly distinct subspecies.

The Samoan Islands were given as the habitat of *M. rufiventris* Elliot (from the Verreaux collection) in the original description. Much collecting in the last seventy years has failed to find that form on the Samoan Islands, and it has become obvious that the type of *rufiventris*, like so many other birds from the Verreaux collection, was wrongly labeled and really came from the Fiji Islands. The recent description of a new subspecies from eastern Fiji (*townsendi*) and the recognition of two additional subspecies from Fiji in the present revision has made it necessary to examine the type in the British Museum. The type is old and faded, and it is somewhat difficult to ascertain its essential characters. The back is rather grayish, the underside light, the under tail-coverts almost whitish. The bird shows thus the essential characters of Viti

Levu birds, and it has seemed to be the wisest action to restrict the type locality to Viti Levu, the largest and most visited island of the Fiji group.

***Myiagra vanikorensis kandavensis*, new subspecies**

TYPE.—No. 251702, Amer. Mus. Nat. Hist.; ♂ ad.; Kandavu, Fiji Islands; November 11, 1924; R. H. Beck.

SUBSPECIFIC CHARACTERS.—Male: similar to *rufiventris* Elliot, but much deeper rufous on the abdomen (almost hazel), under tail-coverts deep ochre or tawny; upperside darker, back always somewhat glossy; light edges on upper tail-coverts, secondaries, lesser under wing-coverts, and tibial feathers narrower.

Female: underside much more richly colored, under tail-coverts ochraceous, extent of white on throat reduced, back darker and less pure gray, crown averaging more glossy, light edges on secondaries and upper tail-coverts reduced.

		WING	TAIL	CULMEN
Kandavu	7 ♂ ad.	70-75 (72.6)	54-61 (57.4)	17-18
Small islands of Kandavu group	6 ♂ ad.	72-75 (73.2)	56-60 (58.0)	
Mbengha	2 ♂ ad.	72, 73	55, 56	
Vatu leile	4 ♂ ad.	74-76 (74.5)	57-61 (59.0)	18-18.5
Total	19 ♂ ad.	70-76 (73.2)	54-61 (57.8)	17-18.5 (18.0)
Ndravuni				
Yankuve	3 ♀ ad.	68, 69, 70	52, 53, 56	17, 17, 18
Vanua kula				

RANGE.—Kandavu, small islands of Kandavu group (Ono, Yankuve, Yankuve lailai, Ndravuni, Vanua kula and Mbulia), Mbengha and Vatu leile.

This subspecies is rather similar to *rufiventris* and differs only in the stronger pigmentation. Birds from Mbengha approach *rufiventris*, just as birds from Koro approach *kandavensis*. Birds from Vatu leile are still darker than the Kandavu specimens.

***Myiagra vanikorensis dorsalis*, new subspecies**

TYPE.—No. 223757, Amer. Mus. Nat. Hist.; ♀ ad.; Matuku Island, Fiji Islands; July 3, 1924; R. H. Beck.

SUBSPECIFIC CHARACTERS.—Male: very similar to that of *townsendi*, but lower back averaging lighter and more grayish; underside more uniformly colored; dark rufous-brown breast-band and lighter colored lower belly not contrasting.

Female: large as *townsendi*, but in coloration intermediate between *townsendi* and *rufiventris*; back deep grayish olive; upper tail-coverts with faint or no light edges; edges of secondaries light buff, edges of wing-coverts olivaceous gray, with a slight ochraceous tinge; forehead and lores grayish, not whitish; underside deep ochre, even richer than in *townsendi*; extent of white on throat varying.

IMMATURE.—Differs from the adult as in *rufiventris*.

MALES				
		WING	TAIL	CULMEN
Matuku	9 ♂ ad.	75-78 (76.3)	60-65 (62.7)	18-19 (18.5)
Moala	10 ♂ ad.	75-78 (76.3)	62-65 (62.9)	
Totoya	4 ♂ ad.	73-76 (74.8)	63 (63.0)	
Naitamba	1 ♂ ad.	79	68	
Yathata	}			
Vatu vara				
Avea, Munia				
Sovu				
Vanua				
mbalavu				
Mango	}			
Thithia		3 ♂ ad.	73-74 (73.6)	59-63 (61.3)
				18-18.5 (18.2)

FEMALES				
		WING	TAIL	CULMEN
Matuku	3 ♀ ad.	73-74.5 (73.8)	59-63 (61.0)	18-19 (18.5)
Moala	1 ♀ ad.	71.5	59	18.5
Totoya	2 ♀ ad.	71, 72 (71.5)	60, 61 (60.5)	19.19 (19.0)
Wailangila	1 ♀ ad.	71	60.5	18
Vatu vara	}			
Mango				
Vanua				
mbalavu				
Avea	}	8 ♀ ad.	71.5-74 (72.4)	59-62 (61.4)
Thithia				17.5-19 (18.4)
		1 ♀ ad.	74	61.5
				18

RANGE.—Southern central Fiji Islands (Matuku, Moala, and Totoya) and northern Lau Archipelago (Wailangila, Naitamba, Yathata, Vatu vara, Avea, Sovu Rocks, Vanua mbalavu, Munia, Mango, and Thithia).

This new subspecies is very similar to *townsendi* Wetmore in the male sex, but differs from that form considerably in the female plumage. A female has therefore been selected as type.

There is a certain degree of individual variation just as in the other races. The males have sometimes more and sometimes less gloss on the back, the gloss is sometimes more greenish and sometimes more bluish. The females are sometimes more grayish on the back, sometimes more olivaceous brown, but never as much as in *townsendi*. The amount of ochraceous on the edges of the wing-coverts is also varying to some degree.

There is also a slight variation in the size as can be seen from the table of measurements. Birds from Totoya, Thithia, and Naitamba are not quite typical.

Myiagra vanikorensis townsendi Wetmore

Myiagra townsendi WETMORE, 1919, Bull. Mus. Comp. Zool., LXIII, p. 205, Kambara Island, Lau Archipelago, Fiji Islands.

SUBSPECIFIC CHARACTERS.—Male: large, with long tail and bill; underside dark, particularly on the lower breast, lighter toward abdomen and under tail-coverts; glossy zone on throat larger, covering also sides of the breast; back more or less strongly glossy; gloss frequently more greenish than in *rufiventris*; secondaries without light edges, upper tail-coverts with glossy bluish or greenish edges; lesser under wing-coverts darker, only with narrow light edges; thighs dark.

Female: large; back more or less light olivaceous-brown sharply contrasting with bluish-gray crown; upper tail-coverts without or with very faint light edges; edges of secondaries pale ochraceous; edges of wing-coverts more or less strongly washed with rich ochraceous; lores and forehead grayish; underparts rich ochraceous, but not so dark as *dorsalis*.

Immature plumages as in *rufiventris*.

MALES				
		WING	TAIL	CULMEN
Kambara	9 ♂ ad.	76-80 (77.8)	64-68 (66.4)	18-19.5 (19.0)
Ongea levu	} 11 ♂ ad.	73-77 (75.8)	62.5-67 (64.9)	17.5-19 (18.2)
Fulanga				
Wangava				
Namuka ilau	5 ♂ ad.	76-78 (77.4)	63-66 (65.0)	18-19 (18.7)
Aiwa	6 ♂ ad.	76-78 (76.8)	64-66 (64.8)	18-19 (18.6)
Vanua vatu				
FEMALES				
		WING	TAIL	CULMEN
Kambara	5 ♀ ad.	71-74 (72.6)	61-65 (63.0)	18.5-19.5 (18.9)
Ongea levu	} 11 ♀ ad.	71-74 (72.0)	59-63 (62.0)	17.5-19 (18.1)
Fulanga				
Namuka ilau				
Aiwa	3 ♀ ad.	73-74 (73.3)	62-65 (63.3)	18-19 (18.3)
Vanua vatu	6 ♀ ad.	71-76 (73.8)	62-67 (64.0)	18.5-19 (18.7)

RANGE.—Southern Lau Archipelago, Fiji Islands (Ongea Levu, Fulanga, Yangasa Cluster, Namuka ilau, Kambara, Wangava, Vanua vatu, Oneata, Aiwa, Lakemba, Komo, Mothe).

The males are remarkably uniform over this range, the females show slight differences on the more isolated islands. Females from Vanua vatu have the underside rather rich ochraceous; such from Aiwa are rather grayish on the upperside, thus approaching *dorsalis*. Unfortunately, there are no adult females from Lakemba in the collection.

SEASON, BREEDING TIME, AND MOLT IN *Myiagra vanikorensis* IN FIJI

The unusually rich material of immature and molting birds of *Myiagra vanikorensis* from the Fiji Islands permits me to draw definite conclusions about the influence of season on the breeding time and molt of this species.

The existence of such a seasonal influence has been shown also in the specimens of *Pachycephala* and *Foulehaio*, treated in some of my previous papers. The material of these species however, came from only a restricted number of islands and did not contain many immature birds. In this respect the material of the species *Myiagra vanikorensis* is much superior, although not quite perfect. No collecting was done by the Whitney South Sea Expedition in the Fiji Islands during March and very little during April, May, and June. The rich material from the other months of the year allows some indisputable conclusions.

The Fiji Islands, although lying in the tropical zone (between 16° and 20° S.), have very definite seasons. There is a steady easterly or southeasterly trade wind blowing from April to October, accompanied by fairly cool weather ("winter season"), and a "summer season" from November to March with warmer weather, frequent calms, and occasional hurricanes. This latter time of the year is the breeding season of most Fijian birds.

The number of birds with enlarged gonads in the different months of the year and the changes of the plumage in the adult birds and in the immature birds contribute the evidence from which I draw my conclusions.

SIZE OF GONADS.—The gonads of adult birds, as described on the labels of the specimens collected on the Fiji Islands, show a varying development during the twelve months of the year.

Condition of gonads	Mart	April	May	June	July	Augt	Sept	October	November	December	January	February
Number of specimens with enlarged gonads	1	1	1	0	6	26	35	18	11	28	22	5
Number of specimens with small gonads	1	1	1	8	26	32	5	3	1	13	17	12
Percentage from total of birds with enlarged gonads	Insufficient material			0	19	45	88	86	92	68	56	30

¹ No material available.

This table shows that the height of the mating season lies in the months of September, October, and November; from then on a distinct falling off can be noticed. In the winter months, May, June, and July, the vast majority of the birds have small gonads. It is interesting to see that the period of enlarged gonads is much shorter with the females than with the males. After November only very few females show any increase in the size of the gonads.

MOLT IN ADULT BIRDS.—All the specimens taken from May to August are in fine fresh plumage. Later in the season (September to November) the first signs of wear become apparent, and practically all the specimens taken in December and January have a very worn plumage. The molt begins in December in one or two specimens, less than 25 per cent of the specimens taken in January are molting, but in February more than 70 per cent of the specimens are in full molt. It can be assumed that the molt is being completed in March (and April), but no specimens are in the collection to substantiate this statement. However, all the birds collected in May and June are in fine fresh plumage.

MOLT IN IMMATURE BIRDS.—The evidence derived from the plumage of immature birds is correlated very closely with the conclusions just presented. If we classify immature plumages into six groups we can arrange them in a table as follows:

I.—Birds in nestling plumage.

II.—Birds molting from the nestling plumage into the immature plumage.

III.—Birds in the immature plumage with a few nestling feathers.

IV.—Birds in fresh immature plumage.

V.—Birds in worn immature plumage.

VI.—Birds molting from the immature into the adult plumage.

	May	June	July	August	September	October	November	December	January	February	March	April
I						1		2	1	2		
II					2			2	2	2	1	
III				1				3	1	1	1	1
IV	1	1	9	6	1		1	1	8	4	1	
V					2	4		1				1
VI							3	8	2			

¹Insufficient material. Specimens in these columns could be expected, if ample collections had been made in the months of March, April, and May.

DISCUSSION.—Practically all nestlings were collected in the months of December, January, and February. Exceptions are two nestlings from Avea, collected in September, and one bird from Matuku with a few immature upper tail-coverts. One bird in fresh immature plumage was collected in November, and one in December. From then on such immatures are common until August, in September and October immatures are more or less badly worn; and in November the molt into the adult plumage begins. The molt of these immature birds is thus earlier than that of the adult birds. It is an open question whether or not these birds begin breeding as soon as they have changed into the adult plumage. In two out of thirteen birds molting into the adult plumage, the gonads are indicated as large or swelling.

Myiagra albiventris (Peale)

Platyrhynchus albiventris PEALE, 1848, 'U. S. Explor. Exped.,' VIII (Birds), p. 102, Pl. XXVII, fig. 3, Upolu, Samoa.

ADULT MALE.—Chin, throat, and upper breast orange-brown (between xanthine orange and amber brown, R. III), sometimes lighter, sometimes darker; feathers of throat with white bases; sides of breast with a patch of bluish-gray feathers; lower breast, abdomen, and under tail-coverts white; forehead, crown, and sides of head black with a strong bluish gloss; back, scapulars, and rump dark gray with a greenish-blue gloss; wing and tail black, feathers with bluish-gray edges; wing-coverts with glossy blue edges; axillaries and under wing-coverts whitish with dark gray centers.

Iris brown, bill bluish black, feet black.

ADULT FEMALE.—Similar to the male, but smaller; patch on the sides of the breast olivaceous gray, not bluish gray; throat lighter; gloss on upper parts much reduced, crown not much contrasting with the back; wings and tail fuscous black, not deep black as in the males.

IMMATURE MALE.—Like the adult female, but duller; edges of wing-feathers and wing-coverts sooty.

NESTLING.—Body plumage downy; upperside sooty, scapulars and wing-coverts with dirty whitish tips; lower breast, abdomen, and under tail-coverts pure white; throat and upper breast buffy ochraceous; feathers on breast with fuscous tips, forming a dark breast-band.

		WING	TAIL
Upolu	9 ♂ ad.	70-74 (72.3)	59-66 (61.5)
	4 ♀ ad.	67-70 (68.8)	57-60 (58.3)
Savaii	8 ♂ ad.	72-76 (73.1)	60-67 (63.1)
	6 ♀ ad.	67-71 (69.2)	58-63 (59.7)

Tarsus, 15-17; culmen, 16-18 mm.

RANGE.—Upolu and Savaii, Samoan Islands.

Birds from Savaii average slightly larger, and males tend to have the back slightly more glossy than Upolu males. These differences are very insignificant, however.

Subgenus **LOPHOMYIAGRA** Mathews

Lophomyiagra MATHEWS, 1928, Nov. Zool., XXXIV, p. 373. Type (by original designation): *Myiagra azureocapilla* Layard.

CHARACTERS.—Bill somewhat inflated without a definite ridge on the mandible; crown covered with a crest of curious stiff silky feathers forming a pattern of decomposed scales.

The only species of the subgenus agrees in all of its essential characters with the other species of the genus, its color-characters coinciding almost perfectly with those of *Myiagra albiventris*. The characters of bill and crown appear to be significant enough to warrant the subgeneric separation of this species.

Myiagra (Lophomyiagra) azureocapilla

RANGE.—Taviuni, Vanua Levu, and Viti Levu, Fiji Islands.

***Myiagra azureocapilla azureocapilla* Layard**

Myiagra azureocapilla LAYARD, 1875, Ibis, p. 434, Taviuni, Fiji.

ADULT MALE.—Feathers of crown and cheeks and ear-coverts pale mazarine blue (R. IX), elongated and with a peculiar structure (between silky and scaly); forehead, lores, superciliary, circum- and post-ocular region blackish; hind neck, partly covered by the crest, bluish black; back, sides of neck, edges of wing-coverts and of secondaries dark slaty blue, sometimes almost blackish; upper tail-coverts black with bluish edges; tail and wings black with grayish-blue edges; throat chestnut, feathers on chin with buff bases, lower throat sometimes suffused with bluish; rest of underside white, feathers with broad black bases, thighs blackish; flanks and under tail-coverts sometimes with a light buffy wash; outermost tail-feathers with narrow whitish tips.

"Iris brown, bill orange, feet grayish green."

ADULT FEMALE.—Crown dark gray, feathers with a glossy blue edge; forehead and lores whitish; circumference of eye more or less whitish; anterior part of ear-coverts fuscous, posterior part whitish; back dark rufous brown, more cinnamon toward the rump; tips of wing-coverts tawny; chin and upper throat whitish, chestnut band across lower throat and upper chest; rest of underside buffy white, flanks with a pale tawny wash; thighs fuscous; under tail-coverts buffy; edges of wing-feathers grayish cinnamon; tail and upper tail-coverts blackish, rather broad whitish tips on the outer tail-feathers.

"Iris brown, maxilla brown, mandible orange, feet greenish."

IMMATURE FEMALE.—Similar to adult female, but all colors duller; crown brownish gray, breast-band much lighter; upper tail-coverts brownish, underside more washed with buff.

	WING	TAIL	CULMEN
11 ♂ ad.	80-86 (83.6)	69-77 (72.8)	16-17
8 ♀ ad.	78-83 (79.9)	68-70 (69.0)	16-17
Tarsus, 21 mm.			

RANGE.—Taviuni Island (Dec. 1924).

Most birds are worn and apparently near the end of the breeding season. One immature female was collected.

***Myiagra azureocapilla castaneigularis* Layard**

Myiagra castaneigularis LAYARD, 1876, Ibis, p. 389, Kandi (Bua), Vanua Levu, Fiji Islands.

SUBSPECIFIC CHARACTERS.—Male: similar to *azureocapilla*, but smaller; throat golden brown, not deep chestnut; this difference is caused mainly by the coloration of the base of the feathers, which is light, not blackish as in *azureocapilla*; blackish base on the feathers of abdomen also reduced, the abdomen thus appearing lighter; upperside more or less as in *azureocapilla*, but crest-feathers shorter; outer tail-feathers broadly tipped, inner tail-feathers narrowly tipped with white, central pair frequently without any white or only a faint edge; axillaries and under wing-coverts also with much more white than in *azureocapilla*.

FEMALE.—Similar to that of *azureocapilla*, but smaller; back more olivaceous cinnamon, less rufous brown, white areas in the eye region and on the ear-coverts much reduced or absent; chin orange-buff, throat golden brown with short light-gray bases to the feathers; abdomen purer white; flanks buffy, not extensively pale tawny; tail-feathers with broad white tips, not with ill-defined buffy whitish tips as in *azureocapilla*.

IMMATURE FEMALE.—Differs from adult female as in *azureocapilla*; back frequently more rufous than that of the adult; mandible brownish.

	WING	TAIL	CULMEN
7 ♂ ad.	72-78 (75.1)	64-72 (66.7)	16-17
5 ♀ ad.	74-78 (75.0)	63-69 (66.2)	

Tarsus, 20 mm.

RANGE.—Vanua Levu, Fiji Islands (Jan., Feb. 1925).

Most specimens are molting and not in breeding condition.

***Myiagra azureocapilla whitneyi*, new subspecies**

TYPE.—No. 252040, Amer. Mus. Nat. Hist.; ♂ ad.; Viti Levu, Fiji Islands; May 5, 1925; R. H. Beck.

SUBSPECIFIC CHARACTERS.—Male: very similar to *castaneigularis*, but slightly smaller; throat darker brown and feathers of crest shorter; back and edges of wing-feathers not so pure blue, more grayish; white tips on tail-feathers much shorter.

Female: very similar to *castaneigularis*, but smaller, throat darker brown, white tips on tail-feathers shorter.

	WING	TAIL	CULMEN
12 ♂ ad.	71-76 (73.6)	62-68 (65.3)	16
2 ♀ ad.	73	60, 60	16

Tarsus, 19-20 mm.

RANGE.—Viti Levu, Fiji Islands.

Most specimens were collected in May and are in fresh plumage, some of the birds collected in March and April are still molting.

MAYRORNIS Wetmore

Mayrornis WETMORE, 1932, Proc. Biol. Soc. Washington, XLV, p. 104. Type (by original designation): *Rhipidura lessoni* Gray.

Muscylva auctorum, nec Lesson; *Haplorornis auctorum*, nec Wetmore.

CHARACTERS.—Rictal bristles not strongly developed; bill slender; tarsi and feet relatively weak; no sexual dimorphism in coloration; small size; otherwise similar to other Polynesian flycatchers.

Mayrornis lessoni

RANGE.—Fiji Islands.

Mayrornis lessoni lessoni (Gray)

R.[hipidura] Lessoni G. R. GRAY, 1846, 'Gen. Birds,' I, p. 258 [based on *Muscylva* de Lesson, 'Voy. au Pole Sud.,' Oiseaux, Pl. XI, fig. 2, Balaou =], Ovalau.

Monarcha cinerea PEALE, 1848, 'U. S. Explor. Exped.,' VIII, p. 101, Viti Levu.

SUBSPECIFIC CHARACTERS.—Bill short and broad; tips of lower rump feathers whitish, upper tail-coverts also broadly edged with white; tertials and secondaries more or less broadly edged with whitish gray; greater upper wing-coverts with broad whitish tips; under wing-coverts prominently white; tibial feathering light gray; cheeks light gray, and superciliary very pronounced.

DESCRIPTION (adult male and female).—Upperside neutral gray, lower rump lighter; upper tail-coverts black with broad whitish tips; wings blackish, edges of primaries and primary-coverts light gray; edges of greater upper wing-coverts and edges and tips of secondaries whitish gray; part of forehead, lores, superciliary stripe, and circumocular feathers white; underside whitish gray, darker on the breast, lighter, almost white on the chin and in the middle of the abdomen; under tail-coverts white; tibial feathers gray with whitish tips; axillaries white, under wing-coverts white with a few grayish spots; tail black, tail-feathers with white tips, which are largest on the outermost tail-feathers occupying about one-third of the feather, and decreasing toward the central feathers; the central pair has only a very narrow white tip.

Iris, brown; bill, bluish; feet, grayish.

IMMATURE.—Very similar to adult, but mandible with a yellow base; plumage of back frequently with an olivaceous wash; edges of primary-coverts, greater upper wing-coverts, tertials and secondaries washed with rufous; tail-feathers narrower and more pointed; first primary rounded. There is a great amount of individual variation in these immatures.

MALES

		WING	TAIL	CULMEN
Viti Levu	}	4 ♂ ad.	67-69 (68.2)	57-60 (58.7)
Malaki				14.1-15.0 (14.5)
Ovalau		2 ♂ ad.	69, 69	59, 59
Kandavu		13 ♂ ad.	67-72 (69.4)	57-63 (60.3)
Vanua Levu		4 ♂ ad.	68 (68.0)	58-61 (59.2)
Rambi		5 ♂ ad.	69 (69.0)	14.1-14.9 (14.5)
Taviuni		4 ♂ ad.	70, 71 (70.5)	14.8-15.5 (15.1)
			59, 60 (59.5)	14.8-15.5 (15.1)

		FEMALES		
		WING	TAIL	CULMEN
Viti Levu	1 ♀ ad.	65	57.5	13.9
Ovalau	4 ♀ ad.	64-68 (66.2)	56, 57 (56.5)	14.9-15.9 (15.3)
Kandavu	6 ♀ ad.	64-67 (65.7)	56-59 (57.4)	13.4-14.1 (13.9)
Vanua Levu	2 ♀ ad.		51	13.6, 14.7 (14.2)
Rambi	4 ♀ ad.	65	57	14.0-15.0 (14.5)
Taviuni	1 ♀ ad.	66	55	14.7

RANGE.—Western Fiji Islands (Ovalau, Viti Levu, Malaki, Mbengha, Kandavu, Yankuve, Vanua Kula, Ono, Mbulia, Vuro, Yanganga, Vanua Levu, Kio, Rambi, Yanutha, Taviuni, and Ngamia). Curiously missing on Ngau, Koro, Vatu leile, and the entire Yasawa group.

The majority of birds from Vanua Levu, Rambi, Kio, and Taviuni are molting. They were collected in December and January.

Birds from the various islands of the range, as stated above, agree fairly well with each other. Birds from Kandavu, Viti Levu, and Vanua Levu have on the average smaller bills. Kandavu birds are rather light, and birds from Vanua Levu have sometimes the white tips of the tail-feathers rather large.

Mayornis lessoni orientalis, new subspecies

TYPE.—No. 251318, Amer. Mus. Nat. Hist.; ♂ ad.; Yangasa Cluster, eastern Fiji Islands; August 8, 1924; R. H. Beck and J. G. Correia.

SUBSPECIFIC CHARACTERS.—Similar to *lessoni*, but much larger; bill long and slender; general coloration darker; lower rump gray as the back, upper tail-coverts pure black; greater upper wing-coverts, secondaries, and tertials with neutral gray, not whitish-gray edges; under wing-coverts with broad grayish bases; tibial feathering dark gray or blackish; cheeks and ear-coverts darker gray; superciliary frequently reduced in size.

		MALES		
		WING	TAIL	CULMEN
Yangasa Cluster	10 ♂ ad.	73-79 (76.2)	66-72 (67.5)	17.1-18.3 (17.8)
Ongea Levu	6 ♂ ad.	75-78 (76.7)	66-71 (68.4)	17.6-17.9 (17.8)
Explorers Islands	9 ♂ ad.	74-77 (75.2)	64-69 (66.6)	17.0-17.9 (17.5)
Moala	10 ♂ ad.	73-76 (74.8)	64-68 (66.4)	17.1-18.5 (17.8)
Tarsus 20-21 mm.				

		FEMALES		
		WING	TAIL	CULMEN
Yangasa Cluster	7 ♀ ad.	72-75 (72.9)	64-67 (65.3)	16.5-17.3 (17.0)
Ongea Levu	8 ♀ ad.	71-74 (72.8)	64-66 (65.2)	16.7-17.4 (16.9)
Explorers Islands	10 ♀ ad.	69-73 (70.6)	61-66 (63.6)	16.3-17.1 (16.8)
Moala	9 ♀ ad.	70-74 (71.9)	62-66 (63.7)	15.9-17.9 (17.1)

RANGE.—Eastern Fiji Islands: Ongea Levu, Yangasa Cluster, Namuka ilau, Marambo, Kambara, Wangava, Mothe, Oneata, Aiwa,

Vanua vatu, Thithia, Vatu vara, Mango, Explorers Islands (Vanua mbalavu, Avea, Munia, Sovu Rocks, Thikombia ilau), Naitamba, and Moala. Not found on: Matuku, Totoya, Fulanga, Komo, Lakemba, Naiau, Tuvutha, and Yathata, islands which were thoroughly covered by the Whitney South Sea Expedition.

This subspecies is rather uniform over its wide range. Birds from Moala and the Explorers Islands are slightly smaller and have a tendency to be darker. The majority of the specimens cannot be separated satisfactorily.

***Mayrornis schistaceus*, new species**

TYPE.—No. 213996, Amer. Mus. Nat. Hist.; ♂ ad.; Vanikoro Island, Santa Cruz Islands; September 24, 1926; R. H. Beck and J. G. Correia.

ADULT MALE AND FEMALE.—Slate-gray, underside, particularly throat, lighter; wings fuscous, wing-coverts and secondaries with slate-gray, primaries with light gray edges; inner edges of wing-feathers whitish; axillaries light gray, under wing-coverts slate-gray; tail black, three outermost pairs of tail-feathers with white or light spots on the inner web; outermost pair also with light shaded area on the tip of the outer web; three central pairs of tail-feathers sometimes with a pale edge; upper tail-coverts black or dark gray.

Iris brown, bill blackish blue with light-colored tomlia, feet bluish-gray.

IMMATURE.—Very similar to adult, but bill yellowish brown; tail-feathers narrower and more pointed; edges of wing-coverts and primary-coverts soft, decomposed and sometimes ochraceous; primaries rounded.

	WING	TAIL	CULMEN
8 ♂ ad.	69-72 (70.4)	60-64 (61.5)	16.5-17.0 (16.8)
14 ♀ ad.	64-70 (67.1)	57-63 (59.7)	15.2-16.4 (16.0)
Tarsus, 20 mm.			

RANGE.—Vanikoro Island, Santa Cruz Islands.

This species seems to be a dark representative of *M. lessoni* (Gray) from Fiji. Considering the fact that there are two species of the genus in the Fiji group, it seemed to be wiser to establish *schistaceus* as a full species. *M. schistaceus* differs from *lessoni* in the darker and more uniform coloration. The white marks of *lessoni*, as for example on the face, throat, under tail-coverts, and tail, are in *schistaceus* much reduced or replaced by gray.

Mayrornis is, so far as we know, the only genus of birds occurring in both the Fiji group and in the Santa Cruz group, but not in the New Hebrides.

***Mayrornis versicolor*, new species**

TYPE.—No. 253934, Amer. Mus. Nat. Hist.; ♂ ad.; Ongea Levu, eastern Fiji Islands; July 28, 1924; R. H. Beck and J. G. Correia.

ADULT MALE AND FEMALE.—Crown, hind neck, back, scapulars, rump and upper tail-coverts deep neutral gray; edges of lesser upper wing-coverts, of primary-coverts, and of secondaries deep neutral gray; outer edges of primaries lighter; inner edge of primaries white; edges of greater upper wing-coverts partly grayish, partly pale ochraceous; underside between light ochraceous-buff and pinkish cinnamon, lighter on chin and upper throat, almost whitish in the middle of the lower belly; under tail-coverts light ochraceous-buff; axillaries buff, under wing-coverts buff with gray bases; forehead, lores, narrow superciliary, and feathers on lower eyelid deep buff; postocular region and ear-coverts mixed grayish and buffy; tibial feathers gray with buffy tips; tail-feathers brownish gray with broad buffy tips which decrease in size gradually from the outermost toward the central pair, which has just a light-colored margin.

Iris brown, bill bluish black with light-colored tomia, feet grayish.

IMMATURE.—Very similar to adult, but bill brownish, mandible yellowish; wings and tail of juvenal structure.

	WING	TAIL	CULMEN
10 ♂ ad.	68-71 (69.7)	58-63 (60.1)	14.7-15.1 (14.9)
5 ♀ ad.	65-68 (66.4)	57-59 (58.2)	14.1-14.9 (14.4)

RANGE.—Ongea Levu Island, eastern Fiji Islands.

It is highly interesting to find this species, the most specialized of the group, restricted to one island. On the same island occurs *Mayrornis lessoni orientalis*. We have thus another case of two immigration waves meeting on the same island without intergradation. There are, however, two specimens in our series of *Mayrornis l. orientalis* from Ongea Levu, which are not quite typical and might be regarded as having *versicolor* blood. Both birds (No. 251204 and No. 251308) are lighter, less grayish underneath. They also have the upper tail-coverts mixed with grayish; one of them has the under parts slightly washed with buff, the other more noticeably so; one bird has a very short bill, and the other has the tips of the tail-feathers washed with buff. We have here a case similar to that in *Myzomela* (see Amer. Mus. Novit., No. 516, p. 24).

AMERICAN MUSEUM NOVITATES

Number 652

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Aug. 14, 1933

59.76 (729.3)

TWO NEW SPECIES OF FROGS, FIVE NEW SPECIES AND A NEW RACE OF LIZARDS FROM THE DOMINICAN REPUBLIC

G. K. NOBLE AND W. G. HASSLER

From October 1929 to January 1930 the junior writer made collections of reptiles and amphibians in Hispaniola on a grant from the Angelo Heilprin Exploring Fund of the American Museum. In 1932, he had the opportunity of continuing this work in a little-known part of the same island through the kindness of Mr. Lorenzo D. Armstrong. Although the object of both expeditions was to secure life-history material, a surprisingly large number of new species was secured. The present paper embraces a description of these new species. An account of the life histories worked out will appear in later publications.

Four of the new species of frogs and lizards were found in the Sierra de Bahoruco, a range of mountains lying in the southwestern part of the Dominican Republic and extending into Haiti. These mountains, unlike most of the surrounding lowlands, receive a plentiful rainfall. Coffee is grown in many sections and a typical rain forest extends over some of the areas which have not been cleared. Collecting was carried on in this range near Polo and Maniel Viejo in the interior and near Barahona and Paradis on the coast.

Early in October 1932, a trip was made to Alta Vela, a small island twenty miles off the extreme southern tip of Santo Domingo and approximately ten miles southwest of Beata Island. No herpetological collections have previously come from this islet so far as we are aware. Although it is only three-quarters of a mile long and half a mile wide, four species of lizards and one snake were found to occur here. Three of these five species were found to be new and both of the others differ in some detail from material from the adjoining mainland. More material is required from the nearby coasts of Santo Domingo and Haiti before the degree of divergence of these two incipient races can be fully stated.

One of these doubtful forms we refer provisionally to *Aristelligella expectatus* (Cochran), although the nine specimens collected on Alta Vela were all slightly redder than our series of forty-three specimens collected

from the Barahona region. The only snake found on Alta Vela we refer to *Typhlops lumbricalis* (Linnaeus). The one specimen secured has 385 scales in a row from head to tail. Our two specimens from Duvergé, D. R., have 297 and 300 scales respectively in the same distance. Our one specimen from the mountains near Barahona has only 289 scales in the same row. However, the head scalation in all these specimens is typical of *T. lumbricalis*, and all have 20 scale rows around the body.

It is highly probable that the *Typhlops*, the *Aristelligella*, and the three species described below represent the entire herpetological fauna of Alta Vela. This island, unlike Beata, to the northeast, rises steeply in the center and is crowned by a double ridge, the higher crest being approximately 500 feet above sea-level. The island is rough, with much exposed rock. The sparse vegetation consists of grass and cacti except along the northern coast and in a few sections of the northern slope of the ridge where some low trees are found. Approximately forty goats and one or two dogs are living in a feral state on the island. The dogs are probably a constant menace to the lizards. No evidence was found of large numbers of sea birds using the island as a rookery and hence the lizards, together with the invertebrates of the shore and young goats, may form the principal food supply for the dogs. One dog was shot while attempting to steal food from the expedition's larder.

***Eleutherodactylus armstrongi*, new species**

DIAGNOSTIC CHARACTERS.—Closely allied to *E. wetmorei* Cochran and to *E. auriculatoides* Noble but differing from either in the narrower head, more extensive series of vomerine teeth, and distinctive coloration. The vomerine series extend lateral to the choanae. The dorsal surfaces are more or less spotted but the posterior surfaces of the thighs, unlike those of *E. wetmorei*, are uncolored or uniformly toned. Further, the spots are small and do not run together to form blotches except bordering the pale dorsolateral and interorbital stripes.

DETAILED DESCRIPTION.—Type: A. M. N. H. No. 44554, adult female. Collected at "El Propio Esfuerzo," coffee finca of Luis E. Del Monte, near Barahona, D. R., at an altitude of 1800 feet, on August 3, 1932, by W. G. Hassler.

Head a trifle longer than broad, not so broad as body; distance between anterior corner of eye and nostril a little less than the greatest diameter of the eye, equal to the interorbital width; distance between nostril and tip of snout contained two times in the distance between nostril and eye; canthus rostralis rounded; tympanum well defined, its greatest diameter a little greater than half the diameter of the eye, separated from the eye by a space a trifle less than its diameter. Tibiotarsal joints of either side slightly overlap when the legs are placed at right angles to the body; tibiotarsal articulation reaches the posterior corner of the eye. Discs of the three

¹Named in honor of Mr. John C. Armstrong who planned the second expedition and assisted in much of the herpetological collecting.

outer fingers well developed, truncate, that of the outer finger as broad as the diameter of the tympanum; discs of the toes and of the inner finger smaller and rounded. Digits free; no tarsal fold, but a very poorly defined ridge present in the position of a tarsal fold. Vomerine teeth caudal to the choanae, in two arched series which begin lateral to the outer margin of the choanae and extend nearly to the midline. Tongue thick, not emarginate behind. Skin very finely granular or irregularly ridged above, belly smooth in the center, slightly granular on the sides, ventral surfaces of the thighs coarsely granular.

Ground tone (in alcohol) a pale gray or brownish; a pair of dorsolateral stripes and a narrow interorbital band a slightly paler tone. Entire dorsal surface of the head and body except for these stripes and the canthal region of each side spotted with dark brown, the spots tending to run together along either margin of the stripes. Dorsal surface of the appendages more finely spotted with the same color; posterior surfaces of the thighs suffused with brown but not spotted. Ventral surfaces of head and body stippled with grayish brown, the tone nearly uniform on the throat and chest but tending to become blotched on the abdomen, the center of which remains uncolored. Ventral surfaces of the limbs stippled or washed with the same color.

DIMENSIONS.—Tip of snout to vent, 35 mm.; width of head, 12 mm.; tip of snout to posterior border of tympanum, 12.5 mm.; fore leg from axilla, 23 mm.; hind leg from vent, 51 mm.; vent to heel, 28 mm.

VARIATION.—The 37 paratypes in the series (A. M. N. H. Nos. 44550, 44558–64, 44598, 44607–8, 44633–41, 44652–65, 44667–9) vary considerably in the degree of spotting. In some specimens (in alcohol) the ground tone on the back between the pale dorsolateral stripes is a chestnut brown nearly as dark as the spotting, which may be much reduced. The spots vary in size and in several specimens fail to form a dark margin to the pale stripes. In other specimens the dorsolateral stripes may extend from the head only to the middle of the back or be absent entirely.

In life the type, when caught at night, was a light yellowish-brown, spotted with darker brown. Next day the dorsal ground tone was a rich golden-brown spotted with very dark brown. The dorsolateral stripes, a region directly over the eyes and extending on either side to the snout, and an irregular bar between the anterior corners of the eyes were clear and translucent. The legs, lateral and posterior portions of the body were light golden-brown with smaller dark spots. The throat was darker than the belly, and brownish. The eyes were yellowish green-gold suffused with brown in the posterior part. The other specimens varied in color, some having a dorsal ground tone of reddish brown with the light areas on the head, the dorsolateral stripes and the arms and legs of a distinct reddish hue; the sides and belly yellowish. Others had a ground color of grayish brown, the dorsolateral stripe and light areas on the head a golden brown; the sides, legs, and throat a grayish brown and the belly white.

HABITAT.—This species appears to be common throughout the region studied, becoming more abundant as the altitude, and hence humidity, increases. A few specimens were taken at 1800 feet and more between 3000 and 3200 feet near Barahona. Other specimens were taken at 2400 feet near Paradis, 3700 feet near Polo, and 3000 feet at Maniel Viejo. They were usually found in the ends of hollow stems and other cavities such as the base of banana leaves and certain mountain palms though occasionally they were discovered among damp leaves and stones on the ground.

***Eleutherodactylus ruffemoralis*, new species**

DIAGNOSTIC CHARACTERS.—A very small species, closely allied to *E. minutus* Noble from which it differs in its finely tubercular skin, its dark dorsal and ventral surfaces, and its distinctive thigh coloration. In life the concealed portions of the flexed thighs were red, while in alcohol these are yellow or pink.

DETAILED DESCRIPTION.—Type: A. M. N. H. No. 44556, male. Collected in a ravine above "Salvation Station" on property of Luis E. Del Monte, near Barahona, D. R., at an altitude of 3000 feet, August 4, 1932, by W. G. Hassler.

Head as long as broad, a little broader than body; distance between anterior corner of the eye and nostril about four-fifths the greatest diameter of the eye, a trifle less than the interorbital width; distance between the nostril and tip of snout contained one and one-half times in distance between nostril and eye; canthus rostralis rounded, the loreal region flat; tympanum distinct, its diameter contained twice in the greatest diameter of the eye, separated from the eye by a space equal to two-thirds of its diameter. Tibiotarsal joints of either side make contact without overlapping when the legs are placed at right angles to the body, tibiotarsal joint extended forward reaches nearly to the anterior border of the eye. Digital dilations very small, the largest of the finger dilations equal to a third the diameter of the tympanum. Digits free; second toe a little longer than the first, no tarsal fold. Vomerine teeth in two oblique groups well behind the choanae and extending outward to about the middle of each opening. Tongue ovoid, not emarginate but extensively free behind. Skin finely tubercular above except for those portions of the skin which are concealed when the appendages are flexed. Ventral surfaces of the thighs, tibial and tarsal surfaces granular; sides of the body granular, but the belly and throat smooth.

Dorsal surfaces of head and body (in alcohol) a dark chestnut-brown; an interorbital bar and some indication of a broad dorsolateral stripe slightly paler than the ground tone. An irregular bar of dark brown extending backward and ventrally on each side of the body from the ear to the groin; dorsally to this on each side a wedge-shaped bar of dark brown bordering the ilium; several spots of dark brown on the sides of the body and bars of the same color across the legs. Concealed portions of the thighs yellowish or slightly pink; posterior surfaces of the thighs below this area brown heavily spotted with dark brown. Ventral surface brown spotted with white, larger spots of white or gray on both upper and lower jaws.

DIMENSIONS.—Tip of snout to vent, 17.5 mm.; width of head, 6.5 mm.; tip of snout to posterior border of tympanum, 6.3; greatest diameter of eye, 1.5 mm.;

diameter of tympanum, 1.1 mm.; fore leg from axilla, 11.5 mm.; hind leg from vent, 28 mm.; vent to heel, 15.5 mm.

VARIATION.—The seven paratypes in the series (A. M. N. H. Nos. 44557, 44596, 44628–31, 44651) vary both in color and in rugosity. In six (in alcohol) there is a distinct dorsolateral stripe of a pale tone and in several there is a series of dark-brown spots on the throat. The double stripe on the side of the body may be broken into spots, but there is always some indication of the upper stripe which borders the ilium. Three of the specimens appear to be nearly smooth above, but these are not so well preserved as the others.

In life, the dorsal ground color was very dark brown, mottled with nearly black. The dorsolateral lines frequently formed crescents of dark golden-brown and were bordered above with black. The bar between the eyes was nearly black as were those on the legs. The concealed portions of the thighs were suffused with a rich reddish-brown. The ventral surfaces were brown spotted with white.

HABITAT.—These tiny frogs are apparently widely spread throughout the mountains, though they are not abundant. Besides the type locality, they were found at 2400 feet near Paradis and at 3700 feet near Polo. As a rule they were among damp leaves and stones on the ground, but one was found at the base of a banana leaf.

***Sphaerodactylus armstrongi*, new species¹**

DIAGNOSTIC CHARACTERS.—A small species, adult males approximately 50 mm. in total length; scales on upper surface of snout and head strongly keeled, two to three times as large as those on the occiput; scales on the upper surface of the body imbricate and keeled, those on the throat, chest, and sides of the body also keeled, while those on the center of the abdomen are smooth. Adult male very dark brown in color with a wide open V on the occiput; two spots on the scapular region, two spots on the base of the tail of a lighter tone. The light spots more or less surrounded with smaller spots of dark brown; some very feeble blotches of dark brown poorly indicated on the upper surface of the head. A dark streak along the side of the head and through the eye; sides of the head lighter than the occiput; a dark streak on the side of the head directly before and behind the eye.

DETAILED DESCRIPTION.—Type: A. M. N. H. No. 51470, adult male. Collected on mountain top on property of G. Herrmann near Paradis, Barahona Province, D. R., 2400 feet, August 25, 1932, by W. G. Hassler.

Snout a trifle less than twice as long as the greatest diameter of the eye; distance from tip of snout to center of eye approximately equal to distance from center of eye to posterior margin of the ear opening; rostral plate rounded with a very feeble lateral ridge or canthus, rostral with a single median cleft behind; nostril surrounded by the rostral, first supralabial, enlarged supranasal, and two other scales of which the

¹Named for Mr. Lorenzo D. Armstrong, whose generosity made the 1932 expedition possible.

more ventral is only one-sixth to one-seventh as large as the dorsal; a single scale separating the supranasals in the midline a trifle larger than the scales covering the forehead; three enlarged supralabials; the most posterior extending well behind the center of the eye; scales on the upper surface of the head posterior to the supranasals keeled, diminishing gradually in size posteriorly, those immediately behind the supranasals only a third to a fourth larger than those between the eyes, but two to three times as large as those on the occiput; six scales in a line between the supranasals and a groove forming the anterior border of the orbit, three or four scales in the anterior part of this row two to three times as large as the small scales immediately behind; nineteen scales in a row across the snout from supralabial to supralabial immediately in front of the anterior border of the orbits; scales covering the upper surface of the body strongly keeled and imbricate; ten scales on the side of the body between the front and hind legs contained in the distance between the tip of snout and center of eye. Longitudinal axis of mental a third longer than same axis of rostral; three enlarged infralabials, the first a little less than twice as long as the second, the second a little less than twice as long as the third. Scales on the ventral surface of the throat, chest, and sides of abdomen keeled; those on the middle of the abdomen smooth, scales gradually decreasing in size from the infralabials toward the throat, rapidly increasing in size immediately behind the throat; the scales on the chest and abdomen two to three times as large as the scales on the throat. A broad band of keeled imbricate scales on the outer surface of the fore limbs, these scales nearly as large as those on the chest; the other scales on the fore limbs small and tubercular; scales on the outer surface of the upper segment of the hind limb similar to the dorsals but smaller, merging gradually into those of the posterior surface of the leg which are much smaller and tubercular; scales on the ventral side of the hind limbs (except for the hypertrophied preanal scales) keeled like those on the sides of the abdomen, but diminishing in size distally. Scales on the dorsal surface of the tail similar to the dorsal body scales but about one-third larger on the anterior part of the tail; ventral scales smooth, varying considerably in size, the average scale measuring about one-third larger than those of the abdomen.

Uniform dark brown above (in alcohol), slightly paler on the snout and sides of the head; a dark streak from the rostral plate through the eye and fading out on the temporal region; a pale, widely opened V on the nape of the neck; two light spots on the scapular region margined with a few spots of dark brown; a few feeble spots of the same tone on the occiput and upper surface of the neck; a pale streak on the lower half of the side of the tail margined above by a streak of dark brown; a few irregular and indistinct spots of dark brown along the ventral margin of the same streak; throat and under surface of neck spotted with brown; ventral surface of limbs and abdomen suffused with the same tone.

DIMENSIONS.—Head and body, 27 mm.; tail, 23 mm.; snout to posterior edge of ear, 6.5 mm.; snout to center of eye, 3.5 mm.; width of head, 5 mm.; fore limb from axilla, 7 mm.; hind limb from groin, 8 mm.

VARIATION.—The only paratype in the series is another adult male (A. M. N. H. No. 51469) which is identical to the type, except that a pair of light spots is visible on the dorsal surface of the tail base. These spots like those of the scapular region are more or less margined with a few dark brown blotches. The general ground tone of the upper surface

is slightly lighter than the type, and the few small spots of dark brown scattered over the upper surface of the head and body are better indicated. In life this species was characterized by its dark tone. The color did not change greatly on preservation.

HABITAT.—These two specimens were both found under stones about twelve feet apart, in the deep channel cut by a small stream. There was no standing water, but the stream bed and steep sides were very damp. The mountain top in the vicinity was covered with rain forest.

***Sphaerodactylus altavelensis*, new species**

DIAGNOSTIC CHARACTERS.—A small species, approximately 50 mm. in total length; very closely related to *S. difficilis* Barbour but differing in a combination of characters. Posterior part of throat covered with a broad band of keeled scales. Ten scales on the side of the body in a distance between that of the tip of snout and center of eye. One or two dark streaks on the posterior side of the thigh extending along the sides of the tail. Adult male and female gray and spotted above with dark brown. A "mask" formed by a dark blotch and a pair of white spots well defined on the shoulders of the immature and feebly developed in the adult female. Streaks on the sides of the head and occiput region of the immature and of most females.

DETAILED DESCRIPTION.—Type: A. M. N. H. No. 51488, adult male. Collected on Alta Vela Island, D. R., October 9–10, 1932, by W. G. Hassler.

Snout a trifle less than twice as long as greatest diameter of the eye; distance from tip of snout to center of eye greater than distance from center of eye to ear opening; rostral plate rounded but with a distinct lateral ridge or canthus; rostral with a single median cleft behind; nostril surrounded by the rostral, first supralabial, supranasal, and two other scales of which the more ventral is only about one-tenth as large as the more dorsal. A single scale separating the supranasals in the midline a trifle larger than the scales immediately posterior to it; three enlarged supralabials followed by three much smaller suboculars; the posterior supralabial not reaching the center of the eye. A cluster of three or four scales on the superciliary margin directly over the dorsal anterior border of the eye distinctly larger than the superciliary scales posterior to them, one of the scales in the group forming an outwardly directed spine; scales on the upper surface of the head posterior to the supranasals keeled, except for two or three scales on the most anterior row; scales between the anterior half of the orbits slightly longer than those on the snout, but only a half or two-thirds as broad; scales on the upper surface of the head behind the orbits diminishing rapidly in size to form a series of very small scales on the greater part of the occiput. Six scales in a line between supranasals and a groove forming the anterior border of the orbit; seventeen scales in a row across the snout from supralabial to supralabial immediately in front of the anterior border of the orbits. Scales covering the upper surface of the body strongly keeled and imbricate; no enlarged scales in the midline; ten scales on the side of the body between the front and hind legs contained in the distance between the tip of snout and center of eye. Mental a little longer than broad, about twice as long as the rostral; three enlarged infralabials, the first approximately twice as long as the second; the second twice as long as the third; the scales in a broad band across the throat and along the sides of the abdomen keeled; those in the middle of the abdomen

smooth; scales on the abdomen two or three times as large as those on the throat. A broad band of scales on the upper surface of the fore limbs covered with keeled imbricated scales on both upper and lower arm, the remaining scales small and tubercular; a similar band of enlarged scales on the entire length of the hind legs keeled and imbricated like the dorsals, but these scales greatly diminishing in size on the lower leg; scales on the posterior part of the thighs small and tubercular; scales on the ventral surface of the hind limb keeled like those on the sides of the abdomen and decreasing in size distally on the leg; a patch of hypertrophied preanal scales forming a triangular patch anterior to the cloaca. Dorsal scales on this regenerated tail keeled like the body-scales and on the anterior part of the tail a trifle smaller than these; scales on the ventral surface of the tail smooth; scales forming the ventral midline of the regenerated portion very broad.

Ground tone (in alcohol) a pale grayish-brown, slightly redder on the tail and head; a series of conspicuous dark brown spots on the entire upper surface; these spots on the upper surface of the head few and of about the same size as the pupil, increasing in number on the occiput, becoming numerous on the body where they average about one-half the size of those on the neck; the dark spots tend to arrange themselves in rows on the posterior body region and are transformed into a dark streak in the inguinal region; another streak of dark brown on the posterior surface of each thigh extending back along the side of the tail for only a short distance (due to the regenerated tail.) Ventral surfaces grayish or straw-color spotted with dark brown on the throat and sides of the body, irregularly streaked with the same tone on the chest and abdomen.

DIMENSIONS.—Head and body, 26.5 mm.; tail (regenerated), 26 mm.; snout to posterior edge of ear, 6.5 mm.; snout to center of eye, 3.5 mm.; width of head, 5 mm.; fore limb from axilla, 7 mm.; hind limb from groin, 9.5 mm.

VARIATION.—An adult female is usually more streaked than a male, and exhibits a "mask" in the scapular region. This mask is formed by a large blotch of dark brown surrounding a pair of white spots. Some adult females are nearly identical in color pattern to adult males but the spots are smaller and tend to streak more. The spotting on the head tends to streak, and in the immature of both sexes as well as in adult females these streaks form a conspicuous crescent on the occiput and have a narrow median stripe extending forward between the eyes. There are also two other dark streaks more or less well defined extending backward from the orbit. Two or three streaks are found anterior to each thigh and two conspicuous ones along the posterior aspect of the thigh and along the tail. The spotting of the ventral surface varies considerably, but in the females there is usually more streaking than in the males.

The dorsal color of these lizards varied in life from light to dark brown. The lighter ones had a decidedly orange tinge on the head and tail. The belly was usually a light yellowish-brown or grayish color.

HABITAT.—Specimens of this species were first found under loose rough chunks of limestone on the rocky headland, thirty to fifty

feet above sea-level at the southeast end of Alta Vela. They were later found under rocks and in crevices in outcropping limestone in the low field at the northern end of the island. Still others were taken from under loose rocks high on the ridges in the center of the island.

REMARKS.—We have compared our series of twenty paratypes (A. M. N. H. Nos. 51472-87, 51489-92) with *Sphaerodactylus* from various parts of the adjacent mainland and have found no specimens which exhibit the combination of characters seen in the Alta Vela series. No doubt several species have been confused under the name *difficilis*, but until the variation of this species has been determined the exact relationships of *altavelensis* cannot be fully seated.

Anolis dominicensis altavelensis, new subspecies

DIAGNOSTIC CHARACTERS.—Closely allied to *Anolis dominicensis* Reinhardt and Lütken of the mainland of Hispaniola, but differing from it conspicuously in its bright reddish-brown color in life; preserved specimens being a pale tan or brownish gray. The scalation of the tail is also distinctive, the scales on the upper surface of the side being larger than in *dominicensis* and gradually increasing in size from the anterior to the posterior margin of each segment. The crest of the tail is lobulated, due to the fact that the third and fourth scales in each segment are larger than the other scales forming the crest of that segment.

DETAILED DESCRIPTION.—Type: A. M. N. H. No. 51050, adult male. Collected at Alta Vela Island, D. R., October 9-10, 1932, by W. G. Hassler.

Head slightly narrower than that of *A. dominicensis*; frontal ridges weakly developed, extending slightly anterior to the orbit; rostral small, one-third narrower than the mentals; four scale-rows between the scales that are pierced by the nostrils; six irregular pairs of roughly rectangular scales on the snout extending from the rostral to the supraorbital semicircles and forming a continuous series with them; these gradually increasing in size posteriorly and each pair making contact in the midline, except for the most posterior pair which are separated by a small scale; supraorbital semicircles on each side making a broad contact with one another in the interorbital region; the anterior pair of scales in the combined series separated for about one-half their length by a small scale which is approximately the size of the scale separating the most posterior pair of enlarged scales on the snout; occipital slightly longer than ear opening and twice as wide, roughly egg-shaped, in contact with the supraorbital semicircles on one side and separated by a single small scale on the other; supraocular disc composed of three large scales on the inner border and three to four smaller ones on the outer border, separated from the semicircles by one or two rows of very small scales. A cluster of three small scales forming the anterior margin of the superciliary, of these the posterior very much longer and narrower than the others; these scales continuous with the canthus rostralis which extends about halfway across the loreal region; the canthus rostralis formed of a single enlarged scale, but anterior to this are three scales belonging to the same series; scales of this series greatly diminishing in size anteriorly; loreal rows four. Scales of the subocular semicircle feebly keeled or slightly tubercular, three of the central scales of this series in broad

contact with the supralabials; supralabials eight or nine, but the last scale which lies behind the midpoint of the eye is smaller than the anterior supralabials. Temporal granules approximately the same size as the dorsals except for those in the midline of the back; temporals gradually increasing in size toward the occipital and toward the supratemporals which form a double row of large scales extending from above the ear to the border of the orbit. Back and sides covered with small, slightly tubercular granules; those of the midline of the back being slightly larger than the others. Ventral surface covered with large smooth imbricate scales; each scale ovoid and three to four times as large as the dorsal granules; throat covered with flat granules slightly larger than the scales on the abdomen; fore limbs covered with small smooth scales except for the anterior margin of the forearm which is covered with a row of scales slightly larger than the largest scales of the dewlap; anterior scales of femur and tibia smooth, similarly enlarged, gradually diminishing in size on the dorsal and ventral surface of the appendage; scales covering hands and feet above enlarged, perfectly smooth. Digital expansions moderate, about sixteen lamellae under second and third phalanges of fourth toe, about twenty-seven under the whole toe. Tail slightly compressed with barely defined verticils, the limits of each being marked by a feebly indicated vertical groove and by two or three vertical rows of slightly enlarged scales; five enlarged spines on the midline of the back in each segment of the tail, the third and fourth of the series being the largest. Very feeble indication of nuchal fold.

Uniform brownish gray above (in alcohol), lighter below; under surface of the appendages straw-colored; dewlap tinged with orange.

DIMENSIONS.—Head and body, 47 mm.; tail (regenerated), 50 mm.; snout to posterior edge of ear, 13 mm.; snout to center of eye, 8 mm.; width of head, 8.3 mm.; fore leg to base of toes, 14 mm.; hind leg to base of third and fourth toe, 24.5 mm.

VARIATION.—The thirteen paratypes of the series (A. M. N. H. Nos. 51037-49), agree with the type in color. They were all reddish brown in life and have faded to a pale fawn tone in alcohol. The head-scales exhibit considerable variance but no greater than has been observed in typical specimens of *dominicensis*. *Altavelensis* is an island form of *dominicensis* exhibiting a constant color difference and apparently constant differences in the scalation of the tail. The peculiar color of this lizard in life is difficult to describe. Specimens were matched in the field as nearly as possible with tints of Winsor and Newton's water-colors. These adapted to Ridgeway's nomenclature of colors would be as follows: The dorsal surface most often approached an ochraceous rufus but ranged to nearly a gallstone yellow. The ventral surfaces varied from gallstone yellow to deep chrome. The dewlap in the males was a dragon's blood red. There were no dark markings on the dorsal or ventral surfaces except occasionally in a very dark individual. In such an individual a faint pattern of fine dark veining was sometime visible all over the body.

HABITAT.—This species was fairly common throughout the small island of Alta Vela, where individuals were seen running on rocks, trees, and bushes from about sunrise until long into the dusk. During the hotter part of the day they remained in shady places. They were very wary and difficult to approach.

***Anolis bahorucoensis*, new species**

DIAGNOSTIC CHARACTERS.—This species is not closely allied to any other *Anolis* in Hispaniola. It differs from other slender-bodied *Anolis* of the Island in being heavier and having a less well-defined band of enlarged scales in the mid-dorsal line of the back. It also differs from these in its smooth ventral scales and in the absence of a dewlap. The very marked sexual dichromatism of the species is another of its distinctive features.

DETAILED DESCRIPTION.—Type: A. M. N. H. No. 51128, adult male. Collected in the Valley of Polo, Barahona Province, D. R., September 14–19, 1932, by W. G. Hassler.

Habitus slender, body compressed, head elongate with sharp canthus rostralis; greatest diameter of the eyes contained three and one-third times in the distance from tip of snout to eye-slit; distance across the head immediately anterior to the orbits contained twice in the distance between the tip of snout and center of eye; frontal ridges very weak, diverging anterior to the eye and then slightly converging to end immediately behind and medial to the nostril on either side; frontal region slightly concave between these ridges; scales on the upper surface of the head anterior to the orbits smooth, scales on the supraorbital semicircles and of the supraorbital discs keeled. Rostral low, about two and one-half times as wide as high; ventral margin of subnasal scale in contact with rostral, nostrils separated from the rostral by a prenasal scale which is larger than the nostril; prenasals separated from one another by a pair of internasals which are slightly larger than either prenasal; a pair of scales immediately behind the internasals, slightly larger than them and making broad contact with them behind and slight contact with one another in the midline; three or four large scales forming the posterior two-thirds of the frontal ridges, these scales two to three times as large as the other scales on the top of the snout which are irregularly polygonal; supraorbital semicircles separated from each other by a single scale at their midpoint and by a wedge of scales immediately before and behind this point; occipital scale about five-sixths as long and three-fourths as broad as the ear opening; occipital scale entirely surrounded by small scales and separated from the supraorbital semicircles by from four to six rows of these small scales; supraorbital discs composed of eight enlarged scales, six of these being much larger than the other two; supraorbital discs separated from the supraorbital semicircles for almost their entire length by a single row of small elongate scales; a single narrow keeled scale longer than the greatest length of the supraorbital disc forming the anterior superciliary margin of the orbit, this scale continuous with a row of seven strongly keeled overlapping scales which form the canthus rostralis of either side; a single enlarged scale mesial to the anterior part of the elongate superciliary scale, this scale separated by two or three rows of small scales from the supraorbital disc; supraorbital region posterior to the elongate superciliary scale and the supraocular disc covered with many small granular scales. Loreal region covered with regular

rows of ovoid scales, the rows increasing from two in front to seven immediately before the orbit; subocular semicircles formed of five or six enlarged keeled scales and a series of smaller ones, which form the posterior part of each semicircle; three of these enlarged scales in contact with the supralabials; supralabials seven or eight, the sixth and seventh and part of the fifth below the eye. Temporal granules about the same size as those on the sides of the body, distinctly smaller than those along the midline of the back; supratemporal line formed of two to three rows of scales only slightly larger than the adjacent temporals; these supratemporal scales about half or a third as large as the small scales forming the posterior section of the subocular semicircle. A band of from two to four enlarged keeled scales extending the length of the back in the midline; scales on the sides of the body only one-half to one-third as large as the mid-dorsal scales, but gradually increasing in size toward the midline; a very feeble indication of a nuchal fold. Scales on the abdomen smooth, imbricate, two to three times as long and three to four times as broad as the enlarged scales of the mid-dorsal line; scales on the throat ovoid; much smaller on the sides of the throat than near the midline; an average scale near the midline of the throat about one-half as large as the abdominals; scales on the extreme anterior portion of the throat, that is directly behind the mentals, about twice as long as wide, about two to three times as long as the more posterior throat scales. No dewlap. Upper surface of the fore limbs covered with imbricate keeled scales; under surface of the forearms with smooth scales of approximately the same size; under surface of the upper arm covered with granules; preaxial surface of the upper leg covered with large scales which are keeled on the upper surface of the limb and smooth on the ventral surface; post-axial surfaces of the upper limb covered with granules; lower leg covered with small keeled scales above and much larger smooth or slightly keeled scales on the ventral surface. Digits of fore limb with relatively smaller enlargements than occur in the hind limb; seventeen lamellae under the fourth finger; thirty-four lamellae under the fourth toe. Tail very slender, approximately two and one-half times as long as the distance from snout to vent; tail only slightly compressed and with a barely differentiated crest; in the center section of the tail the scales on this crest only one-third to one-fourth larger than the scales on the side; about six vertical scale-rows on the side of the tail between one cleavage groove and the next; two enlarged post-anal plates.

Ground tone of the dorsal surface (in alcohol) a slate gray; four broad bars of reddish brown extending across the back between the fore and hind limbs, each bar edged with very dark brown; an oval spot of gray marking each cross-bar at its intersection of the mid-dorsal line; the lower sides of the body dark brown spotted with gray or white; some ill-defined grayish spots on the neck and back of the head, the most conspicuous of these forming a semicircular bar behind the orbit; upper and lower eyelids white; legs and tail brownish gray above and on the sides feebly cross-barred or blotched dark brown and white; ventral surface of the throat and abdomen white suffused with gray on the lower jaw and posterior part of the throat; under surfaces of the appendages white tinged with brown, especially on the posterior limbs.

DIMENSIONS.—Head and body, 46.5 mm.; tail, 113.5 mm.; snout to posterior edge of ear, 15.5 mm.; snout to center of eye, 10.5 mm.; width of head, 8 mm.; fore leg to base of toes, 14 mm.; hind leg to base of third and fourth toe, 29 mm.

VARIATION.—The seventy-five paratypes (A. M. N. H. Nos. 51081–127, 51129–56) show marked sexual dichromatism. Thirty-four are

males, thirty-nine are females, and two are sexually immature. The males are uniformly cross-barred but the females show variations of a longitudinal striping or an approach toward the cross-bars but never the complete broad saddles of the males. In some of the males these cross-bars are not interrupted on the mid-dorsal line as in the type. The females are more uniformly brown in tone and in life do not show the vivid green of the males. In some females the junction of the lighter color of the back and the dark of the sides forms nearly straight dorsolateral lines. In others these dorsolateral lines are wavy and in a few the dark brown extends up from the sides at intervals and very nearly reaches the center of the back, or does so in a few places.

The females do not attain the size of the males, the longest one in the collection measuring 41 mm. from snout to vent, as against 49 mm., the longest male. Moreover, the head is proportionately shorter in the females. Usually the females are distinguished from the males by the absence of the two enlarged scales just posterior to the vent on the under surface of the tail. Some females, such as A. M. N. H. No. 51114, verified by dissection as to sex, may have a pair of large post-anal scales but these are not so well developed as in adult males. In the majority of females, however, these enlarged scales are either entirely lacking or are very small.

In life, the male is an extremely beautiful lizard. In its usual and brightest phase the dorsal surface of the head is an olive-green; the neck a lighter green, spotted with brown. The back is a bluer green while the four broad saddles or cross-bars are a tone of burnt umber. The dorsal surface of the tail, for the anterior two-thirds, is a yellowish green with several dark brown bars. The posterior end of the tail is brown. The side of the head is greenish brown back to the eye. The upper eyelid may be a vivid golden yellow. The posterior corner of the lower lid may be blue or purplish. Just posterior to the eye is a narrow patch of dark brown, followed by a crescent of light blue or white. Posterior to this the side of the head is a brownish green merging into the lighter green of the side of the body which is peppered and veined with brown. Extending from a point on the upper labials anterior to the eye along the sides of the body nearly to the hind leg is a slightly broken white or cream-colored line edged with brown and suffused in the region over the front leg with yellowish green. The legs are light brown above with slightly darker bars. They are nearly white beneath. The ventral surface of the abdomen is cream-colored, faintly tinted with brown and

green. The throat is the same color with several rows of very faint brown spots along the sides.

This species changes color rapidly and to a marked degree. When the lizard is caught or frightened these colors may almost instantly become darker, the green changing to gray or dark brown with the brown cross-bars growing darker and almost black edged. The head becomes dark brown and the labials greenish. The pineal region becomes white and very conspicuous. The ventral surfaces turn greenish or yellowish and the spots become more distinct.

Throughout the region studied this species was comparatively common in moist situations at altitudes over 1500 feet. The first specimens discovered were on ferns and low bushes along a stream at an altitude of 1800 feet on the coffee finca of Señor Luis E. Del Monte near Barahona. The estate was later collected over up to 3200 feet, and the lizards were found in various places up to that altitude. Near Paradis they were found on the property of Mr. G. Herrmann where collecting was carried on between 1800 and 2400 feet. At Polo they were found in the valley at 2300 feet and in the neighboring mountains as high as 3700 feet. Also at Maniel Viejo at 3000 feet. Palomino Springs, near Barahona, was the lowest place where they were observed, a few being taken along a stream at 1500 feet. It is believed that the lower mountain sides are not humid enough for the species. It was much more terrestrial in its habits than the other species of *Anolis* in the same locality, being found on the ground and on low brush in coffee groves and forested areas. Its favorite habitat, however, was on low plants, leaves and trash along mountain streams and in humid ravines.

The specific name refers to the Sierra de Bahoruco throughout, which range the lizard appears to be abundant.

***Lelocephalus altavelensis*, new species**

DIAGNOSTIC CHARACTERS.—Closely allied to *Lelocephalus barahonensis* Schmidt from which it differs in its conspicuously spotted head; the throat grayish in the female or dark bluish-black in the male, but always with some indication of white spotting in both sexes. No conspicuous spots or stripes on the body, but the female with feeble bars of dark brown across the back and frequently some indication of a pale dorsolateral stripe. Scales behind ear keeled and imbricate, not granular. Three scales on each side between the rostral and supraorbital ring; the posterior separated from the canthus by a wedge-shaped scale. About fifty scales around the middle of the body; hind leg reaching between the ear and eye.

DETAILED DESCRIPTION.—Type: A. M. N. H. No. 51055, adult male. Collected on Alta Vela Island, D. R., October 9–10, 1932, by W. G. Hassler.

Anterior head-shields smooth, posterior ridged; three enlarged scales, a supranasal, a prefrontal and a frontal on each side of the snout between rostral plate and supraorbital ring; the posterior of these three scales more than twice as large as either of the anterior; these three scales on each side separated from the homologous row on the opposite side by a median row of three scales; the supranasals narrowly in contact anteriorly; nasals and supranasals in broad contact with rostral; frontal separated from the canthus by an elongate wedge-shaped scale; two or three scales between this elongate scale and the nasal; two heavy rounded canthus scales followed by four long and very narrow superciliaries, the first three of which greatly overlap; a single small scale between the anterior canthus and the nasal; six enlarged supraoculars separated from the superciliaries by a single row of small scales except anteriorly where one or two extra scales are intercalated; three pairs of enlarged scales between the supraorbital rings, the anterior pair much larger than the others; occipital small and separated from the two posterior pairs of these enlarged interorbital scales by a row of three small scales; a pair of elongate parietals on either side, the median pair making broad contact behind the occipital; four or five scales, half the size of the occipital, or less, between the lateral pair of parietals and the small temporal scales. Four upper labials and four and a half lower labials to a point below the center of the eye; temporal scales increasing gradually in size, the last one, just above and in front of the ear, the largest and most conspicuous; anterior border of the ear opening with three or four coarse projecting scales. Dorsal scales, large, imbricate, mucronate; the laterals about two-thirds as large as the dorsals, becoming smoother and more rounded toward the lower portions of the sides; ventrals approximately as large as the dorsals, smooth, their posterior edges slightly denticulate; about fifty scales around the middle of the body; about fifty-eight scales from the occiput to a point directly above the vent, sixteen dorsal scales the equivalent of the distance from snout to occiput; nuchal scales small, those on the sides of the neck like the dorsals, those behind the ear keeled and imbricate, not granular. Shoulder folds present; no lateral folds. The adpressed hind limb reaches halfway between the ear and the eye. Digits compressed; the fourth toe with 26 tricarinate lamellae. A feeble crest along the back and tail base; tail compressed; scales on the under surface of the tail about as large as the dorsals; postanal scales slightly enlarged.

Dorsal surface of the head and body (in alcohol) cinnamon-brown faintly tinged with metallic green and spotted with yellow or gray; the spots on the dorsal surface of the head nearly as large as the scales, while those on the back are much smaller and those on the posterior surfaces barely distinct; sides of the head, neck and body as well as the whole throat a blue-gray; sides of the head, throat and chest spotted with white; sides of the body with several vertical rows of pale blue spots; the spots tend to run together on the side of the head where they form two vertical bars across the jaws and eyelids and on the chest where they form a broken cross-bar. Under surface of the legs and middle of the abdomen straw-color.

DIMENSIONS.—Snout to vent, 60 mm.; head to posterior edge of ear, 15.5 mm.; tail (regenerated), 38 mm.; fore leg, 24 mm.; hind leg, 44 mm.; width of head, 11.5 mm.

VARIATION.—The twenty-two paratypes (A. M. N. H. Nos. 51051-4, 51056-73) show little variation. The feeble spotting of the dorsal surface of the body is often inconspicuous but the head is always distinctly spotted both above and below. In the female a series of transverse bars

or widely opened V's of dark brown are frequently found on the back; the throat is always much paler gray than the male's but the white spots may be more numerous and smaller. The tail of the type is regenerated and does not show the crest which in the unregenerated tail is better developed than along the middle of the back.

In life, the yellowish-brown dorsal color was overlaid with a golden-bronze sheen. The head was slightly darker, almost every scale being edged with dark brown while the sides of the head were darker still. Usually there was no distinct pattern on the back. One adult male, just before shedding, showed faint cross-lines on the back but these were less distinct after shedding. The dorsal surface of the legs was darker than that of the body and showed light spots but no bars. The tail was light yellowish-brown, lighter than the body and with extremely faint, narrow cross-lines. The side of the body was a greenish hue with scattered spots of a bright metallic green covering individual scales. The throat was a bronzy, dark brownish black with small white spots, often running together. Toward the chin the throat became less bronzy. The belly was yellowish with sometimes a slightly green tint. In young specimens the tail was more orange. No marked sexual dichromatism was noticed in the field.

HABITAT.—This species was common on the island of Alta Vela, living among the rocks, leaves and grass along the coast and ranging to the top of the higher ridge in the center of the island.

***Mabuya lineolata*, new species**

DIAGNOSTIC CHARACTERS.—A slim, short-legged species having ten stripes of dark brown extending the length of the body; supranasals in contact behind the rostral; two pairs of nuchals; when the limbs are pressed along the side of the body, the appendages fail to meet by a distance greater than or equal to the length of the hind limbs.

DETAILED DESCRIPTION.—Type: A. M. N. H. No. 42145, female. Collected at Monte Cristy, D. R., January 8, 1930, by W. G. Hassler.

Snout short; a small postnasal present; anterior loreal making a narrow contact with the first labial; supranasal in contact behind the rostral; frontonasal broader than long, making contact with the anterior angle of the frontal; prefrontals barely separated by the frontonasal; frontal about one-fifth longer than the frontoparietals; about the same length as a parietal, in contact with the second supraocular only; four supraoculars, second one-half again as large as any of the others; four superciliaries, second as long as the third and fourth combined; a pair of frontoparietals, about the same length as an interparietal; parietals in contact behind the latter; one pair of nuchals; four supralabials anterior to the suboculars; one or two suboculars followed by a supralabial which is larger than the anterior supralabials and slightly higher than the suboculars. Ear opening ovoid, a trifle smaller

than the diameter of the transparent plate in the lower eyelid, its greatest diameter about equal to length of the scales covering the side of the body. Dorsal scales smooth; 26 scales around the middle of the body, laterals a little smaller than the others. When the legs are pressed against the body the hind leg fails to meet the anterior leg by a distance greater than the total length of the hind limb; subdigital lamellae smooth; tail regenerated, nevertheless slightly longer than the head and body length.

Dorsal surface of the head, body and tail (in alcohol) striped, a ground tone of gray divided on the dorsal surface by ten conspicuous stripes of dark brown, the two most ventral stripes on each side, about half the width of the two stripes immediately dorsal to them on either side; the latter extending from the region of the eyes the whole length of the body and well on to the tail; the dark stripes not co-equal in width to a scale but extending through the middle or the lateral portion of each scale. Ventral surface a uniform grayish tint except on the tail where the two most ventral stripes on the side of the body have converged to form two barely defined stripes on either side of the midline of the tail.

DIMENSIONS.—Snout to vent, 59 mm.; axilla to tip of longest finger, 10.5 mm.; groin to tip of longest toe, 15 mm.; tip of snout to ear opening, 8.5 mm.; greatest breadth of head, 6 mm.

VARIATION.—Of the two paratypes, an adult male (A. M. N. H. No. 51766), measuring 56 mm. from snout to vent, is almost identical to the type, having the same distinctive color pattern and short legs. When its hind leg is pressed forward and its fore leg backward, the distance between the appendages is approximately equal to the length of the hind leg. The head-scales are essentially like those of the type, but there is only one elongated subocular on each side. The other, a young specimen (A. M. N. H. No. 51765), 27 mm. from snout to vent, differs from the two adults in the series by having a stripe on either side of the body in addition to the ten stripes of dark brown found in the adults. There is also some indication of five other longitudinal stripes of brown along the ventral surface of the belly.

In life the dark stripes were nearly black while the light ones were lemon-yellow, changing into bluish at the tail-base. The tail was blue and the whole color pattern greatly resembled that of *Ameiva lineolata* Duméril and Bibron.

HABITAT.—The species is known only from the region of Monte Cristy, Dominican Republic. The type was secured by a native who said he found it under rubbish near the bank of the Rio Yaque del Norte, not far from Monte Cristy. The other two specimens were brought in by natives from the same region. They were mistaken for *Ameiva lineolata* due to the remarkable resemblance in size and color. Despite the fact that over 300 of the *Ameiva* were brought in and the junior writer made a special search for them, no other specimens of *Mabuya* were secured.

59 57, 89 P

NOTES ON THE GENUS *PHOEBIS* AND THE DESCRIPTION OF
A NEW SPECIES

By F. MARTIN BROWN

Several years ago I published a revision of the genus *Phoebis* (1929, American Museum Novitates, No. 368). Since then I have had an opportunity to examine additional collections. In one made in Ecuador by Mr. G. H. H. Tate, of The American Museum of Natural History, I found a unique male related to the species *eubule* but quite distinct from it. It is, in fact, the only clearly defined species of the genus to come to light during the past fifty years.

Phoebis tatei, new species

Figures 1, 2, 3

MALE.—The upper surface has a ground color of ochreous yellow to buff, with broad margins of lighter chalky scales. Approximately two-thirds of the fore wing is covered by a chalky scaling which extends from the apex to the second cubitus vein and completely across the wing from the outer margin to the costal margin including the cell, except the basal portion. It then runs along the outer margin to the outer angle in a band almost one-fourth the width of the wing and tapers along the inner margin almost to the base. On the hind wings the chalky area is more restricted, being almost one-eighth the width of the wing and extending along its outer margin from the costal margin to the second cubitus. The hind wings are noticeably emarginate, especially toward the anal angle where there is a tendency to a lobe. A small group of brown scales forms a discal spot on the fore wing, and the discal spot of the under surface shows through on the hind wing.

The under surface is dull ochreous-yellow covered with fine wavy lines of Indian red and heavier Indian-red markings quite similar to those found on *P. eubule* Linnaeus. The discal spot of the forewing is light pinkish-brown surrounded by dark brown; that of the hind wing is double, silvery, and very narrowly margined with dark brown. There are small dark spots along the margin at the terminal of each vein and fold. The abdomen is ochreous with a dark brown band along the dorsum. The antennae are seal brown with narrow lighter bands at the junctions of the segments.

The valvae are subtriangular, the dorsal margin smoothly rounded and surmounted by a small papular marginal process; the distal process is slightly prolonged and rounded at the end, which has a tendency to be bulbous. The harpes are slender, pendant, and armed on the posterior margin and the tip with short notched spines. The margin of the valvula is heavily "chitinized." The annellus is long and heavy; the juxtae are short, slender, and filamentous. The uncus is delicate, terminating in a slender, pointed digital process; the vinculum is sturdy. The sacculus is heavy and

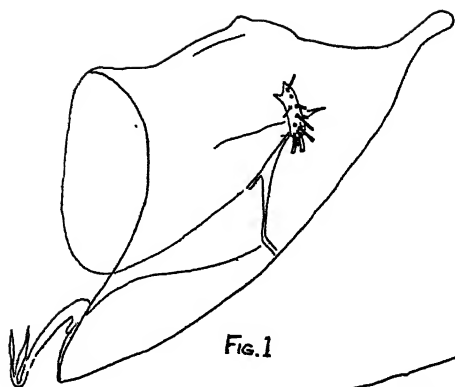


FIG. 1

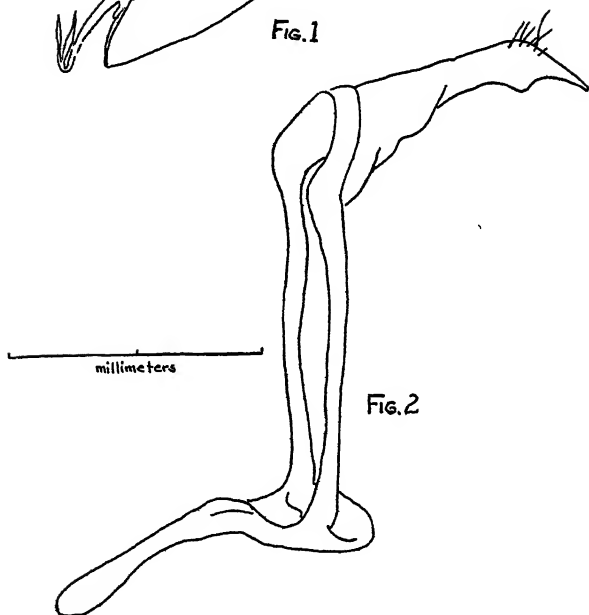


FIG. 2

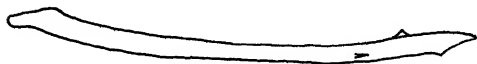


FIG. 3

Fig. 1. Valva, *Phoebis tatei*, new species (type).

Fig. 2. Uncus, etc., *Phoebis tatei*, new species (type).

Fig. 3. Aedoeagus, *Phoebis tatei*, new species (type).

longer than the uncus. The aedoeagus is moderately stout, slightly curved, and armed on the distal end with two or three spines.

HOLOTYPE MALE.—A single specimen from Guayaquil, Ecuador, taken in May, 1922, by Mr. G. H. H. Tate. Type in the collection of The American Museum of Natural History.

P. tatei more closely approaches *P. eubule* than it does any of the other species of the genus. It differs from *eubule* in the following characters: general color; the great extension of the chalky scaling on the fore wings; the more sharply arched costal margin of the fore wing; the more acute apex; the less curved inner margin of the fore wing; the tendency to a lobe at the anal angle of the hind wings; and the antennae being seal brown in *tatei* and magenta in *eubule*.

On the basis of genitalia this is as distinct a species of *Phoebis* as any now recognized. It differs markedly from *P. eubule* in the structure of the valvae, resembling it only in that the spines on the harpes are notched. The valvae are most like those of *P. (R.) triti* Linnaeus. It differs in having smaller harpes, which are pendant, while those of *triti* are erect and massive. It also differs in the lack of labides and in that the distal process is shorter than in *triti*. The uncus of *tatei* differs from both *eubule* and *triti* in the form of the digital process and in general build. The aedoeagus is more like that of *eubule*, except that it is a much lighter structure.

***Phoebis editha* (Butler)**

Figures 4, 5, 6

After working up the genus in 1929, in which study I had dissected many males, I turned to the females and soon found that *editha*, which I had considered synonymous with *thalestris* Illiger and had placed as a seasonal form of that species (p. 9), was quite distinct. This led to a correspondence with Captain N. D. Riley at the British Museum in regard to the male type. Captain Riley made a dissection of the type, and it proved to be a good species. I am reproducing in this paper a set of drawings based on the originals made for me by Captain Riley, to whom I here wish to express my gratitude. The following is a description made from these drawings.

The valvae are subtriangular; the dorsal margin is smoothly concave, the marginal process long and slender, the distal process stubby and rounded, and the disto-ventral margin smoothly rounded. The harpes are long, slender, pendant, slightly swollen at the distal end, and armed with moderately long notched spines. The uncus is long and heavy and the digital process prominent and almost straight. The vinculum is sturdy. The saccus is heavy but not quite so large as the uncus.

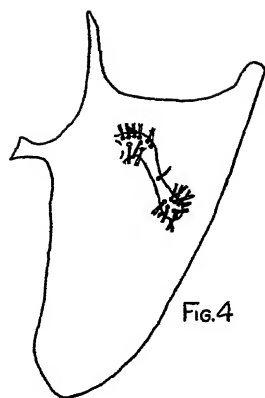


FIG. 4

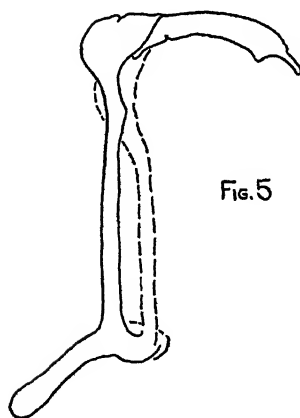


FIG. 5

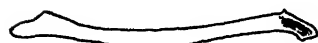


FIG. 6

Fig. 4. Valva, *Phoebis editha* (Butler) (type).

Fig. 5. Uncus, etc., *Phoebis editha* (Butler) (type).

Fig. 6. Aedocagus, *Phoebis editha* (Butler) (type).

Note:—Figures 4, 5 and 6 have been redrawn from the originals made for the author by Captain N. D. Riley of the British Museum.

The aedoeagus is moderately stout, slightly curved throughout, with a very sharp reflexion at the distal end and armed distally with a few short, sturdy spines.

The genitalia of this species may be distinguished from all others in the genus by the combination of two characteristics on the valvae: the notched spines on the harpes and the long slender marginal process. I know of no means of distinguishing the males from those of *eubule*. The only male specimen of which I know is the type. From Butler's figures ('Lepidoptera Exotica,' plate xxxix, figs. 1, 2, 3, 4), I think it would pay to make a careful examination of all male "*eubule*" from the island of Hispaniola, especially the Haitian end. The fore wing of the male *editha* seems to be somewhat falcate, and the under surfaces seem to be much brighter orange than is usual in *eubule*, although I have seen *eubule* that approach it closely. Inasmuch as the females are by no means uncommon, I believe that a diligent search will uncover additional male specimens of this obscure species. An examination of the genitalia can be made *in situ* by carefully brushing the scales from one of the valvae and determining the form of the process on the dorsal margin of that organ. In *eubule* it is mammillate and low; in *editha* it is long and slender.

A CORRECTION

In my revision, 1929, American Museum Novitates, No. 368, p. 13, I stated that *Prestonia clarki* Schaus was possibly a synonym of *Phoebis argante* Fabricius. I have since seen the type and it is a distinct genus and species unrelated to anything else in the Neotropical fauna.

BIBLIOGRAPHY OF ORIGINAL DESCRIPTIONS

- argante* FABRICIUS, 1775, 'Syst. Ent.,' p. 470, No. 116.
clarki SCHAUS, 1920, Proc. U. S. N. M., LVII, p. 109.
editha BUTLER, 1870, Trans. Ent. Soc. London, p. 10, No. 4.
eubule LINNAEUS, 1766, 'Syst. Nat.,' II, p. 764, No. 102.
tatei BROWN, new species.
thalestris ILLIGER, 1802, 'Magazin,' I, p. 207, No. 31.

AMERICAN MUSEUM NOVITATES

Number 654

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Sept. 6, 1933

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MOUNTED SKELETON OF *TRICERATOPS ELATUS*

By HENRY FAIRFIELD OSBORN

The completion of this mount marks an important step forward in our knowledge of the Ceratopsia and especially of the genus *Triceratops*. Four outstanding points are: (1) The correct formula of the Pes in this genus; (2) The widely spread position of the fore limbs; (3) the connection of the prepubis with the posterior ribs; (4) the composition of the skeleton as a whole which, in harmony with the three-horned skull, proves that the characteristic pose is highly resistant to attack. As to point (2), while the hind limbs are vertical, as in previous mounts, the fore limbs, unlike previous mounts, stand widely apart to brace the head, with its horns and shield, against powerful attack probably from carnivorous dinosaurs of the *Tyrannosaurus* type. We shall return to the pose and work of mounting after describing the materials of which this mount is composed.

A COMPOSITE SKULL AND SKELETON

Amer. Mus. Nos. 5033, 5045, 5039, 5116 (originals); modeled parts after Amer. Mus. 970, 971 and 973.

This composition of bones belonging to four individuals and found in two states, Montana and Wyoming, renders it probable that the skull and skeleton represent more than one species, yet it appears to be correct in proportion.

ORIGINAL MATERIALS.—The basis of the mount is the skeleton Amer. Mus. 5033, found by Brown and Kaisen on the expedition of 1909, sixteen miles southeast of Lismas, Montana. This number includes two cervical, fourteen dorsal, and seven caudal vertebrae, twenty-eight ribs, a complete pelvis and sacrum, a complete right hind limb and foot, and a complete left femur.

In the same Montana locality was found Amer. Mus. 5045, a coarsened series of cervical vertebrae; also from the same locality a lower jaw (Amer. Mus. 5039).

SKULL.—A beautifully preserved skull (Amer. Mus. 5116) was found by the veteran collector Charles H. Sternberg on Seven Mile Creek, Niobrara County, Wyoming, in 1909 and was presented to the American Museum by Mr. Charles Lanier.

RESTORED FORE LIMBS.—The fore limbs are restored in plaster chiefly from Amer. Mus. 970, from Hell Creek, Montana, 200 feet above Fort Pierre, and from other individuals, mostly of larger size than this skeleton, including some guidance from the National Museum mounted skeleton (Nat. Mus. 4842).



Fig. 1. *Triceratops elatus*, American Museum composite skeleton. Direct lateral view. One-thirty-fifth natural size.



Fig. 2. *Triceratops elatus*, American Museum composite skeleton. Oblique anterior view. One-thirty-fifth natural size.

These materials were placed in the hands of Mr. Charles Lang, and the restoration, reconstruction, modeling of missing parts, and final mounting of the skeleton and skull in 1923 are chiefly his work, principally guided by his studies of living reptiles and of scores of photographs from the Zoological Park, but also by unwearying thoroughness in trying out every modification in pose, articulation of the bones, and reconstruction of the ribs that appeared possible. The discovery of the relation of the posterior thoracic rib to the prepubis by ligamentous attachment is due chiefly to him.

PRINCIPAL PROPORTIONS OF THE SKELETON IN METERS.

Vertical square of length, rostrum to tip of tail.....	5.80 = 19 ft. 1 in.
Total length following curves, rostrum to tip of tail.....	7.08
Thorax, broadest area of, opposite eleventh thoracic.....	1.50
Highest point of spine above coracoid.....	1.77
Highest point of spine at sacrum.....	2.165
Highest thoracic spine in vertebral column.....	2.305
Greatest spread of fore limb at elbows (=4-foot tread).....	2.10
Greatest spread of hind limb, across pes (hind tread).....	1.35
Skull, total length occipital condyles to rostrum.....	1.12
Vertebral column, atlas to tip of caudals.....	5.96
Total length of fore limb, head of humerus to distal phalanx of D.III.....	1.69
Total length of hind limb, head of femur to tip of ph. 4.....	2.23
Ratio, brachio-crural (brachio=arm, crural=leg).....	76%

From the above principal measurements and with the photographs which are here reproduced to a uniform scale of one-thirty-fifth, the proportions of all parts of the skeleton may be calculated.

DETAILED MEASUREMENTS IN METERS

VERTEBRAE, TWENTY-THREE PRESACRALS, TEN SACRALS

Total linear measurements of vertebrae, "cervicals" including total of eight centra.....	.83
Total linear measurements of vertebrae, "cervicals" including total of four consolidated centra.....	.44
Thoracics, fifteen free centra.....	1.74
Sacral plus dorsosacral, ten centra.....	.985
Caudals, seven original bone, thirty-eight restored, total forty-five, estimated.....	2.37

GIRDLES AND LIMBS

Fore Limbs:

Head of humerus, to D.III, ph. 3.....	1.69
Restored scapulo-coracoid.....	1.44
Humerus, head to end of condyle.....	.80

Radius:	
Proximal to distal end.....	.40
Ulna:	
Olecranon to distal end.....	.635
Hind Limb:	
Head of femur to D.IV, ph. 4.....	2.23
Femur:	
Head to endocondyle.....	.950
Tibia:	
Proximal to distal end.....	.61
Fibula:	
Proximal to distal end.....	.63
Pelvic Girdle:	
Prepubis, total length of.....	.64
Prepubis, spread across right to left prepubes.....	1.34
Postpubis, free portion of.....	.36
Prepubis plus postpubis.....	.86
Ischium.....	1.05
AXIAL SKELETON	
Length from rostrum to tip of caudals following curve.....	7.08
Entire vertebral column following curves.....	5.96
SKULL	
Occipital condyle to rostrum.....	1.12
Frill, top of, to base of manus.....	2.30
Total length of, frill to rostrum.....	1.95
Front of orbit to rostrum.....	.855
Front of orbit to back of frill.....	1.15
Frill, total width of.....	1.25
Jaw:	
Articular to predentaries.....	.995
Horns:	
Supra-orbital length, orbit to tip.....	.83
Supranasal, height of.....	.135
Width, supra-orbitals across tips.....	.73

SPECIFIC REFERENCE.—The specific reference of the skull is to *Triceratops elatus* Marsh, by Dr. Richard S. Lull, the leading American authority on the Ceratopsia. He writes (letter, June 21, 1924): "I consider that the skull should be referred to *T. elatus* from the following characters: (a) the elevated parietal crest without marginal epoccipitals, which, however, may have been lost during fossilization, (b) the reduced nasal horns, (c) the forwardly directed supraorbital horns. *T. calicornis* Marsh is closely related to *T. elatus* if not conspecific. The mounted skull (Amer. Mus. 5116) is somewhat similar to that mounted in the National Museum; neither gives me the impression of the type of *Triceratops prorsus* in the New Haven Museum. As compared with *T.*

elatus, *T. prorsus* is distinguished by the following characters: (a) The nasal horn of *T. prorsus* is larger, (b) the rostrum does not extend so far in front of the nasal horn, (c) the parietal crest of *T. prorsus* is quite different, being deeply impressed with blood vessels which extend inwards on the inferior aspect for a distance of several inches from the periphery, (d) the epoccipitals are also present."

POSE OF MOUNTED SKELETON

POSE OF THE HEAD.—The pose represents *Triceratops* charging with the head down and turned a little to the left as the animal drives forward. The head is slightly tipped to one side with the straight horns in a nearly horizontal position; this transmits the impact of the horns directly to the occipital condyles and the neck. This set of the skull, with the horns pointing directly forward at the object of attack, is obviously required by the mechanics of the action. The skull has a wide range of adjustment, pivoting on the joint of the condyles as a center, the whole skull forming a combination of pike and buckler in the occipital crest, very quickly adjusted to the needs of attack or of defense.

POSE OF THE FORE LIMB.—The pose of the fore limb, set out widely apart from the body, is also designed to withstand attack, like the widely spreading feet of the pugilist or wrestler. With the humerus horizontal, the left foot reaches forward while the right foot is propelling the body just before it leaves the ground for the next step. The hind limb is totally unlike the fore limb in pose, the femur being subvertical as compared with the horizontal humerus, and the knee being only slightly everted. The hind and fore limbs are in alternating phases of the stride; the right hind limb reaches forward immediately behind the left fore limb, while the left hind limb reaches backward propelling the body strongly forward.

The widely spreading pose of the fore limb is the final result of a long series of experimental poses and of studies of numerous photographs not only of mammalian quadrupeds (for the action of the hind limb), but of iguanas, monitors, and other lizards, crocodiles and giant tortoises (for the action of the fore limb). After repeated attempts to pose the fore limb, with the humerus subvertical and the elbow more or less pointed backward (as in mammalian quadrupeds), it appeared, as observed by Dr. W. D. Matthew, "that neither of these poses could be worked out without disjuncting the articulations in a quite impossible manner. Nothing short of a horizontal humerus and completely everted elbow would permit of proper articulation of the facets and place the

chief muscle processes and attachments in proper and mechanically possible relations. The fore limbs cannot be posed at all like those of a rhinoceros, nor apparently could the animal adopt the relatively straight position taken by a crocodile in running. The large lizards afford nearer parallel in the pose of the limb, while the tortoises appear to be the best guide for the feet. The tortoise has the humerus horizontal but reaching forward and outward from the shoulder-joint, while in *Triceratops*, the humerus reaches backward and outward but never forward at any phase of the stride.

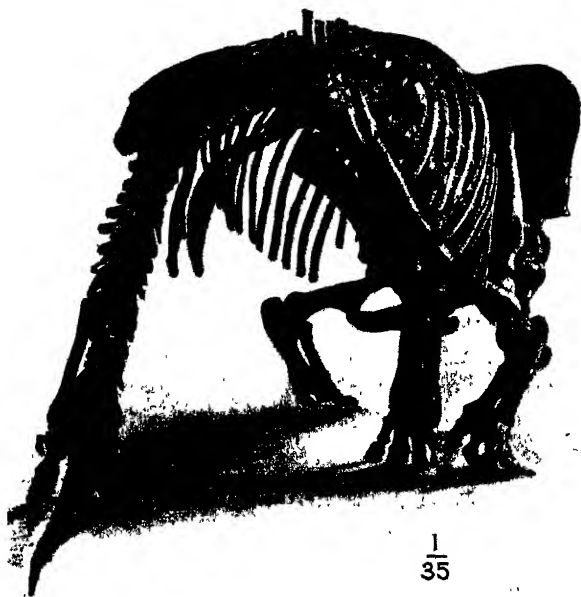


Fig. 3. *Triceratops elatus*, American Museum composite skeleton. Oblique rear view. One-thirty-fifth natural size.

"A large part of the forward and backward movement of the manus is accomplished through rotation of the humerus upon its axis. The remainder is a cumulation of the forward and backward movement of the humerus from the shoulder-joint, the forward and backward movement of the ulna and radius on the elbow-joint, and the movement of the metapodials on the wrist and of the phalanges on the finger-joints. A certain amount of twisting in the backbone and shoulder-girdle also adds to the

length of stride, which in spite of its apparent cramping by the limitations upon the movement of the humerus, is as long as that of the free-swinging hind limb. The heavy strain of supporting the great body on these widely-spread fore limbs is very apparent but there seems to be no other way to pose the skeleton. A compromise pose, such as that of the National Museum mounted skeleton (or of Marsh's restorations so far as they can be interpreted) serves to reduce, not to banish the anatomically impossible disjointing."

POSE OF THE FEET.—In the restoration of the fore limbs, the plaster reconstruction of the scapula, fore limb, and the foot, is chiefly based upon *Triceratops* (Amer. Mus. Nos. 970 and 973), supplemented by Amer. Mus. 971; the exact arrangement of the phalanges is based upon complete skeletons of *Monoclonius* in the American Museum, in which these phalanges are preserved in place. Thus restored, the fore feet have rather the short, flat character of the tortoise feet than the round, compact, cylindrical form of the mammalian quadruped; it is quite impossible to throw the metapodials into any such sharply convex form as those of the elephant, nor would the distal ends of the radius and ulna admit of it. There is, however, some convexity of the articular facets and this has been expressed by the facets and form of the foot bones.

SHOULDER GIRDLE.—The muscular relations of scapulae, coracoids, and sternal plates were carefully studied by Dr. William K. Gregory and rest upon several lines of evidence; the relations as seen in the skeletons of *Monoclonius* and others found in articulation; the contouring of the ribs, showing as generally among vertebrates a certain amount of hollowing beneath the swell of the subscapular muscle; the requirements for the throat passages and muscles, and especially the relations of the muscular attachments throughout.

RIBS.—In Amer. Mus. 5033 the fifteen presacral ribs of one side were preserved and not badly crushed, so that the restoration of the thorax in a natural curve is probably nearly correct. Agreeing with previous authors, Hatcher, Lull, and Gilmore, the vertebral column is arbitrarily divided into:

8 cervicals, the three anterior consolidated.

14 thoracics, with rib-bearing free centra.

10 sacrals, centra more or less consolidated.

The arrangement of the ribs on these thirty-two cervico-dorso-sacrals is as follows:

Atlas consolidated with cervicals 2-3. No rib known.

Axis consolidated, pleurapophysis, spine. First rib.

Cervical 3, bicipital rib and spine.

Cervicals 4-8 with bicipital ribs increasing rapidly in length.

Thoracics (=dorsals) 1-14 with bicipital ribs increasing in length to the 8th dorsal, diminishing in length to the 14th thoracic; 14th thoracic bicipital rib uniting superiorly with anterior border of ilium; 13th connected in its midsection with anterior border of prepubis. First sacral with vestigial rib beneath ilium.

Thus on these eight cervicals, fourteen thoracics and first sacral, we find all together remnants of *twenty-two* more or less complete ribs extending from the second cervical to the first sacral inclusive.

The thirteenth thoracic rib is especially important, since it forms a ligamentary connection near the middle of its length with the anterior end of the prepubis, the thickness of the bone for this articulation and the surface being very clearly marked. In previous mounts the prepubis has been placed inside the posterior rib.

THORAX.—The width of the thorax and position of the ribs are largely determined by the articulations of the head and tubercle; the final position given is as near as practicable to the sharp backward pitch of the ribs in most reptiles, differing considerably from the direct outward extension of the ribs in most herbivorous mammals. Thus the thorax of *Triceratops* retains the trihedral form characteristic of reptiles, with broad flat under surface extending backward from the flat coracoid-sternal portion of the shoulder girdle; and with sloping sides less strongly convex than in mammals. The narrow sternal region of most quadrupedal mammals is in contrast with these proportions.

PÆLVIS.—The sacrum and ilia are consolidated along with the adjacent dorso-sacral, the primary sacrals, and first caudo-sacral vertebrae (ten in all). The backward pitch of the ilium is conditioned by its articulation with the dorsal vertebrae and the natural curve of the presacral series, together with the relative height of the girdles as determined by the articulated fore and hind limb. It is more steeply pitched than in Marsh's restoration, somewhat more than in the National Museum mount, but it could not be articulated differently save through maladjustment of the vertebral facets, changes in the pose of the limbs or in the position of the scapula. The steep pitch of the ilia conforms well to the short and reduced caudal series. The ischia are not so much recurved distally as in the National Museum mount; the position of the pubes has already been noted.

HIND LIMB.—In contrast to the fore limb the hind limb bones are articulated with a subvertical femur, and the knee only a little everted. This corresponds to the mammalian pose and contrasts with the pose of



Fig. 4. *Triceratops elatus*, American Museum composite skeleton. Two anterior views. One-thirty-fifth natural size.

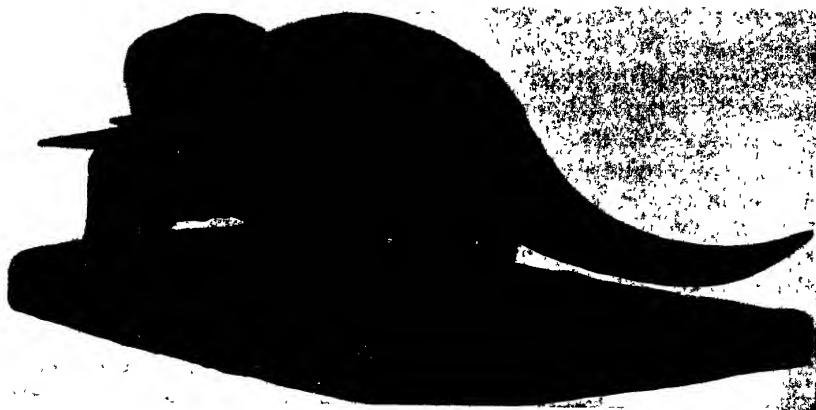
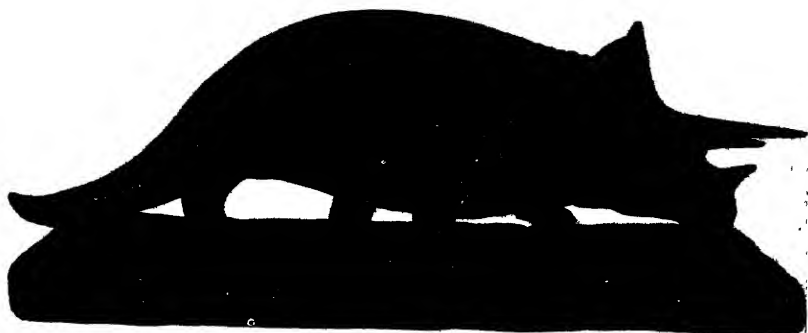


Fig. 5. Three views of *Triceratops elatus* model, made by Charles J. Lang.

lizards. The evidence is primarily the relations of the femoral joints and the position of the processes and attachments for the principal leg muscles. The head of the femur projects internally somewhat as in mammals, rather than proximad as in *Varanus* or *Iguana*, while the distal facets face chiefly distad instead of being limited to the posterior face of the bone as in these genera. A certain amount of eversion of the knee appears to be necessary to clear the swell of the posterior portion of the thorax, but the free fore-and-aft swing of the nearly straight hind limb is in marked contrast to the movements of the fore limb. The feet, however, seem to have been comparatively broad, short and spreading as in tortoises, not compactly rounded as in proboscideans. The pes is tetradactyl as in *Monoclonius* with the first four digits bearing hoofs; digit I with two phalanges, digit II with three phalanges, digit III with four phalanges, digit IV with five phalanges, and digit V represented by the reduced metatarsal.

CURVATURE OF BACKBONE.—There is a double curve, as in mammals, unlike the straight run of the vertebrae in *Sphenodon*, lizards or crocodiles; but it is much less than in any of the restorations hitherto made. This alteration is based upon the actual fit of the centra; they are articulated with facets parallel and zygapophyses in place. This is regarded as the best evidence of the normal articular relations of the vertebrae. The curve adopted by Marsh in his restoration and in the mounted National Museum skeleton was presumably based upon the curvature of a series of vertebrae, *T. brevicornus* type (Yale Univ. Mus. 1834), as actually preserved in the rock (see *Ceratopsia* Monograph, 1907, Pl. XL). This curvature, however, must be regarded as probably corresponding to that usually seen in the various articulated dinosaur skeletons discovered in Montana and Alberta in recent years. As observed by Matthew and Brown (Amer. Mus. Novitates No. 89), these skeletons ordinarily have the backbone bent and the neck recurved dorsad, to the extreme limit of flexure. Although this is the usual position in the fossil skeleton, it is obviously not a normal position during life and should not be taken as a guide to the reconstructed skeleton.

OBSERVATION BY GREGORY AND MATTHEW

The above notes on the special features of the pose in our mounted skeleton were largely supplied by Dr. W. D. Matthew. The following comments are added by Dr. William K. Gregory (letter June 24, 1924): "1. All the apparent anomalies in the fore and hind limbs of *Triceratops* (elbows widely everted, knees turned forward, mixture of lizard-like

and proboscidean suggestions) are entirely explicable by Dollo's theory that the Ceratopsia are secondarily quadrupedal, the gigantic descendants of small upright, running dinosaurs. The skeletal characters of *Protoceratops* are almost exactly intermediate between the two stages and furnish the keystone of palaeontological evidence in the cumulative morphological argument. 2. I do not find any mention of the new alignment of the bones surrounding the acetabulum, by means of which the acetabulum becomes a functionally effective structure for articulation with the head of the femur. This new adjustment is also correlated with the new position of the prepubic process, which in our mount diverges sharply forward so as to encompass the abdominal cavity instead of sticking into the middle of it as in earlier restorations. Anteriorly the prepubic processes articulate with one of the presacral ribs, which have a peculiar sigmoidal flexure and a roughened surface apparently for contact with this process. One of our *Monoclonius* skeletons has the prepubic process actually in contact with this sigmoid rib. 3. The comparison of *Triceratops* with the quadruped rhinoceroses and proboscideans relates only to very superficial characters dependent upon vegetarian habits and huge bulk. All the nearest morphological resemblances in the pelvis and hind limbs are with birds, not with ungulates. 4. The *Triceratops* skeleton affords the most striking example of the concepts of habitus and heritage. The habitus characters, like later writings on a palimpsest, overlie and obscure the older characters or heritage. The habitus is the sum of all those characters which adapt the animal to its final peculiar mode of life; in this case, that of a gigantic herbivorous quadruped. The heritage is the sum of all those characters which it has received from an earlier mode of life; in this case, that of a small upright, running, *Psittacosaurus*-like, herbivorous ancestor of the Ceratopsia."

The time actually consumed in mounting this *Triceratops* skeleton is as follows:

Mr. Charles Lang.....	161½ days
Mr. Paul Bultman.....	102
<hr/>	
Total number of days.....	263½ days

This includes restoring and mounting, but not the time spent in freeing the specimen from the matrix.

BIBLIOGRAPHY

- HATCHER, JOHN B. 1907. 'The Ceratopsia.' Monograph U. S. Geol. Surv., XLIX. Based on preliminary studies by Othniel C. Marsh, and edited and completed by Richard S. Lull.
- BROWN, BARNUM. 1917. 'A Complete Skeleton of the Horned Dinosaur *Monoclonius*, and Description of a Second Skeleton showing Skin Impressions. Bull. Amer. Mus. Nat. Hist., XXXVII, Art. X.
- MATTHEW, W. D., AND BROWN, BARNUM. 1923. 'Preliminary Notices of Skeletons and Skulls of Deinodontidae from the Cretaceous of Alberta.' Amer. Mus. Novitates No. 89, pp. 1-10, text-figs. 1-5.

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NEW AMERICAN DOLICHOPIDAE

BY M. C. VAN DUZEE

Twenty species of dolichopods which seem to be new are described in the present paper. Thirteen of these are from North America, one from the Windward Islands, West Indies, one from Peru, two from Brazil, and two from Guatemala. In addition to the descriptions of new species I have added some remarks on the antenna of *Argyra barbipes* Van Duzee and have also proposed a new name for a preoccupied name appearing in my paper in American Museum Novitates, Number 599, March, 1933.

Chrysotus brasiliensis, new species

Length, 1.3 mm.

MALE.—Face wide above, about half as wide below; face, front, palpi, proboscis, and antennae black; palpi small; third antennal segment small, about as long as wide, somewhat rounded at tip, arista subapical; lower orbital cilia whitish; occiput green, with white pollen.

Dorsum of thorax metallic black with brown pollen; pleura black, whitish pruinose. Abdomen shining black; hypopygium reddish brown, moderately large, with very minute yellow appendages at tip.

All coxae, femora, tibiae, and tarsi pale yellow; middle coxae blackish at base on outer surface; last segment of all tarsi more or less blackened; anterior coxae nearly bare and without bristles; femora without long hair below; front tibiae without bristles above and all tibiae without bristles below; middle and hind tibiae with bristles above, which are scarcely as long as diameter of tibia and with a row of shorter, black, bristle-like hairs on lower posterior edge; all tarsi plain, their hairs mostly yellow; all pulvilli very small, length of front tibiae as 25, middle as 32, and posterior as 36; segments of front tarsi as 13-6-5-4-4; of middle tarsi as 16-8-6-4-4; of posterior pair as 7-10-5-5-4. I cannot see the calypters or their cilia; halteres black.

Wings almost hyaline; third and fourth veins straight and parallel; from the root of the wings to the cross-vein as 19, from cross-vein to apex of wing as 47; first vein very short, not reaching as far as the cross-vein.

HOLÓTYPE.—Male, taken December 29, 1919, at Corumba, Matto Grosso, Brazil.

C. brasiliensis differs from *proximus* Aldrich, which was taken at Jamaica, in having all pulvilli very small; *proximus* also has two long stout bristles at tip of abdomen and the thorax and abdomen bright green.

Chrysotus nigriciliatus, new species

Length, 2.3 mm.

MALE.—Face linear, brown, of nearly equal width; palpi and proboscis black; front bright, shining green; antennae (Fig. 1) black, a little oblique above, rather large, one and one-third times as long as wide; lateral and inferior orbital cilia white.

Dorsum of thorax and abdomen bright shining green, with bronze reflections, almost wholly without pollen; five dorsocentral bristles; three pairs of acrostical bristles visible (some may have been broken off) on posterior half of the dorsum; the hairs of the abdomen appear yellowish, the bristles black; hypopygial appendages black, triangular, moderately large with black hairs on the edge.

All coxae, trochanters, femora and hind tibiae and tarsi black, front and middle femora a very little yellow at tip; front and middle tarsi black from the tip of first segment; all tarsi plain, posterior pair rather thick and densely black-haired; front tibiae with one small bristle above near base, none below; middle tibiae with one very small bristle near base above; on anterior surface at basal fourth is a large bristle, which is as long as its distance from base of tibia, and near the middle is another small bristle on anterior surface; on lower anterior edge is a row of rather long, stiff, black hairs. Hind tibiae quite thick, with long abundant black hair; there are several bristles above, and on both the anterior and posterior edges of lower surface they have a row of close-set, bristle-like, black hairs; length of front tibiae as 34, of middle as 41, and of posterior pair as 48; segments of front tarsi as 19-8-5-5-6; of middle pair as 22-9-7-4-5; of hind pair as 18-11-7-5-5. Calypters yellow with black cilia; knobs of halteres yellow.

Wings slightly grayish, a little darker in front of second view; third and fourth veins straight and parallel, fourth reaching the wing margin a little in front of the apex of the wing; cross-vein far before the middle of the wing.

HOLOTYPE.—Male, taken August 31, 1916, at Hanover, New Hampshire.

This differs from both *currani* and *barbipes* Van Duzee in having the cilia of the calypters black; from *currani* it also differs in having the third antennal segment large and oblique above; from *barbipes* it differs in that the base of third antennal segment does not project at all over second segment.

Keirosoma slossonae, new species

Length, 4 mm.; wing, 4.2 mm.

MALE.—Eyes touching in the middle of the face, leaving a rather long green triangle above and a smaller reddish-brown triangle below, which is almost black part of its length; front shining green; palpi very small, black; antennae (Fig. 2) yellow, third segment mostly brown, pointed at tip, arista inserted a little beyond apical third; second segment overlapping third on inner side. Occiput a little concave, black, gray pollinose; orbital cilia short and apparently wholly black.

Dorsum of thorax green with blue reflections, posterior slope reddish coppery; scutellum large, cut off straight apically; pleura black, white pruinose. Abdomen compressed, black with coppery reflections, second to fifth segments each with a white pollinose, basal band, which is narrowly interrupted in the middle, when seen from above, by a fine coppery line; hypopygium (Fig. 3) reddish brown, partly concealed,

its outer lamellae slender, black, about as long as third antennal segment; hairs on the abdomen mostly pale brown, posterior margins of the segments with long black bristles.

Front coxae black, yellowish on apical half, nearly bare anteriorly, with large bristles at tip; middle and hind coxae black, a little yellowish at tip; trochanters dark yellow; front and middle femora black, narrowly dark yellow at base and on apical half; hind femora dark yellow, black on upper edge; all tibiae rather dark yellow, posterior pair black on apical fifth; front and hind tibiae without bristles below; middle tibiae with one long bristle below at basal third; all tibiae with many large bristles above; all femora with rather long hair below; all tibiae and tarsi with long, stiff hair, especially above and below; length of front tibiae as 75, of posterior as 108; segments of front tarsi as 35-15-14-10-8; of middle pair as 48-28-18-12-12; of posterior pair as 30-39-28-23-14. Calypters and halteres yellow, former with broad black margin and dense black cilia.

Wings gray, tinged with brown in front of third vein and along the posterior veins; third vein and last section of fourth vein nearly straight, somewhat divergent toward their tips, fourth ending back of the apex of the wing; first vein reaches about half-way to the cross-vein; last section of fifth vein straight, its length as 48, cross-vein as 28; anal angle of wing rather prominent.

HOLOTYPE.—Male, taken at Biscayne Bay, Florida, by Mrs. Slosson.

This differs from the generic type species, *albicinctum* Van Duzee, in having the antennae large and pointed at tip, fore coxae and femora largely black, and hypopygial lamellae longer. *K. albicinctum* has third antennal joint small and nearly round in outline; all femora and the fore coxae wholly yellow, and hypopygial lamellae shorter.

***Syntormon nubilum*, new species**

Length, 3 mm.

MALE.—Face rather wide, black, with white pollen below; palpi black with brown pollen; front a little more metallic than the face, brown pollinose. Antennae (Fig. 4) wholly black, third segment slightly longer than wide, scarcely pointed at tip, arista inserted just above the point, second segment overlapping the third for half its length; orbital cilia wholly black.

Thorax and abdomen dark green, the former with a little whitish pollen, and the latter with black hairs; hypopygium concealed.

Coxae and femora black, extreme tips of femora and the tibiae yellow; hind tibiae shading into brown, apical third brownish black; front coxae with black hairs; front tibiae with two bristles above, one at basal fourth and one at middle, none below; middle tibiae above with one pair of large bristles at basal third, one at apical third, a single bristle between these pairs and a small one before the basal pair, also a pair below at apical third; hind tibiae above with three pairs of large bristles and a single one; below with two large bristles on the middle third; all tarsi plain, except the posterior basitarsi (Fig. 5) which are slightly arched and have five small bristles below, which are straight and scarcely as long as diameter of segment; front and middle tarsi a little yellowish at base, hind tarsi wholly black; length of front tibiae about as 51, middle as 74, and posterior as 91; segments of anterior tarsi as 26-11-9-6-8;

of middle pair as 32-16-11-8-6; of posterior pair as 25-25-20-13-11. Calypters and halteres pale yellow, cilia of former black.

Wings uniformly slightly tinged with brown; third and fourth veins nearly straight and parallel, fourth ending in the apex of the wing; last section of fifth vein straight, its length as 37, cross-vein as 19; anal angle of wing a little prominent.

FEMALE.—Lower part of face a little projecting; face with a little more white pollen; hind femora more decidedly yellow and the black at tip more sharply limited; antennae (Fig. 6) slightly smaller; wings and general color about like that of male.

Described from two males and one female, all taken by W. H. Brown, at Bradore Bay, Quebec.

TYPES.—Holotype, male, and allotype, female, taken August 2, 1930; the male paratype was taken July 16, 1930.

The only other described species from North America with plain hind basitarsi is *vanduzeei* Curran, from Ontario. That species differs from this form in having all the femora yellow.

***Parasyntormon longicornis*, new species**

Length, 2.5 mm.

MALE.—Eyes contiguous, the small triangle above, large triangle below, front and palpi opaque with white pollen; antennae (Fig. 7) black, first segment yellow below at tip, slender, three times as long as width at tip; second segment overlapping third less than width of third segment; third segment three times as long as wide, a little oblique at tip, but scarcely concave, arista inserted at basal fourth, nearly bare; orbital cilia white.

Dorsum of thorax green with obscure brownish stripes; scutellum blue-green with one pair of long marginal bristles, a pair half as long outside of these and a few small black hairs on the disk; acrostical bristles in two somewhat irregular rows of eight pairs; prothorax with two or three small yellowish bristles above front coxae; pleura mostly black, white pruinose. Abdomen dark green, more or less of sides of second and third segments and the venter of first four segments yellow; hairs on sides of abdomen yellow, those near the base very long; hypopygium (Fig. 8) covered with yellow hairs, which are conspicuous; outer lamellae long and slender, black, inner appendages more yellow, one pair somewhat club-shaped.

Front coxae wholly yellow with a few white hairs and stout black bristles at tip; middle and hind coxae mostly yellow; femora and tibiae yellow, hind femora a little brown above at tip; first three segments of front tarsi yellow, apical half or more of fourth and whole of fifth segments black; middle and hind tarsi black from tip of first segment; anterior femora with a row of yellow bristles below, which are as long as second segment of front tarsi; front tibiae with a row of hairs as long as diameter of tibia on lower anterior surface and one bristle above near basal third; middle tibiae with two bristles below and one above near basal third; middle and hind femora each with a row of hairs on lower posterior edge, which are a little longer than the other hairs on the femora; length of fore tibiae as 45, middle as 67, and of posterior pair as 95; segments of front tarsi as 23-10-7-6-5; of middle pair as 35-15-12-10-5; those of posterior pair as 17-26-16-11-8; front tarsi (Fig. 9) with four bristles below on basal half of first segment, second segment enlarged below, especially at tip; other tarsi plain. Calypters yellow with black tip and yellow cilia; halteres yellow.

Wings grayish; third and fourth veins nearly parallel, a little arched, fourth ending in the apex of the wing; sixth vein almost wholly wanting; anal angle of wing not at all prominent, last section of fifth vein straight, its length as 45, cross-vein as 14.

FEMALE.—First and second antennal segments almost as in the male, but a little shorter, third a little longer than wide, arista short; front tarsi colored as in the male, plain, except that the first segment has a row of about ten bristly hairs below; segments of front tarsi as 23-14-11-7-5; anterior femora and tibiae without long hairs or bristles; hairs of front coxae black; wings as in the male, except that sixth vein is distinct on its basal half and the anal angle is more prominent.

Described from three males and one female, taken May 19, 1931, on Kiger Island, Oregon, by J. Wilcox.

This species would come near *emarginicornis* Curran, which was taken in Alberta, but that species has third antennal segment twice as long as wide and conspicuously concave at tip; it has plain legs in the male; the cilia of the calypters black; and the eyes not contiguous.

***Parasyntormon petiolatum*, new species**

Length, 2.3 mm.

MALE.—Face narrow, brown with a little white pollen; front blue, almost black; palpi and proboscis black with black hairs; antennae (Figs. 10 and 11) black, first segment thick, second overlapping third for one-sixth its length, third segment quite abruptly narrowed a little beyond its middle, forming a slender point, arista apical, one-fifth as long as the segment, antennae and arista densely pubescent; orbital cilia wholly black.

Dorsum of thorax dark green, quite shining, with brown pollen, which is visible when viewed obliquely. Abdomen coppery; hypopygium brown with yellowish-brown lamellae, which are narrow and about as long as height of hypopygium, fringed with long yellowish hairs, the ones at tip scarcely longer than those on the sides.

The front coxae appear to be yellow (they are largely buried in glue). All femora and tibiae yellow, tips of posterior femora above and apical fourth of their tibiae blackish; front tarsi (Fig. 12) yellow, last three segments more brown, first segment with three long bristles below near base, second segment swollen below, fifth segment a very little widened; middle tarsi blackish from tip of first segment; hind tarsi wholly black; length of front tibiae about as 30, middle as 49, posterior pair as 60; segments of front tarsi as 25-10-7-7-6; of middle pair as 30-15-11-8-6; and of posterior pair as 16-22-13-9-7. Calypters yellow with a narrow brown border and long yellow cilia; halteres yellow.

Wings gray, brownish in front of second vein; third vein and last section of fourth vein a little arched, nearly parallel, fourth ending in the apex of the wing; last section of fifth vein straight, its length as 28, cross-vein as 11; anal angle of wing very prominent; wings wide.

HOLOTYPE.—Male, taken September 3, 1920, at Del Monte, Monterey Co., California.

This species is the fourth in which the third antennal segment is as long as the face, or longer, wholly black, with a very short, entirely

apical arista; *asellus* Wheeler has the tip of the segment broadly rounded, without a sudden narrowing on either side. The other three species have the segment abruptly contracted at or beyond the middle, on one side: of these three, *fraterculus* Van Duzee has all femora and the anterior coxae largely black, the other two (*mulinum* Van Duzee and *petiolatum*, new species, described above) have the front coxae wholly yellow. *Mulinum* differs from the new form in having four bristles on basal half of front basitarsus, first three segments of hind tarsi about of equal length, cilia of calypters black, and hypopygial lamellae fringed with black hairs.

***Sympycnus brevipes*, new species**

Length, 1.5 mm.

MALE.—Eyes contiguous, obliterating the face, palpi and proboscis blackish brown; first two antennal segments yellow (Fig. 13), third black, rather large, as long as wide, rounded; arista dorsal; orbital cilia pale below.

Dorsum of thorax opaque with light brown pollen; acrostical bristles in an irregular row, rather long; pleura brown, but the sutures, posterior edge and part of lower portion yellow. Abdomen black, upper part of first three segments dark reddish, sides of second and third segments with large, triangular, yellow spots; hypopygium and the apical segments shining black; hairs on the abdomen mostly yellowish, bristles on the sides of first segment and hairs on lower part of second and third segments black; venter yellow; hypopygial lamellae somewhat rod-like, blackish, with long hairs; central organ yellow, about as long as the lamellae.

Coxae, femora, tibiae and most of the tarsi pale yellow, tarsi a little brownish apically; front coxae with a few white hairs and two curved, black bristles at tip; front tibiae with one bristle above at basal third; middle femora with two preapical bristles, one on each side; middle tibiae with one stout bristle near basal fourth and one at middle above, also two at tip; hind tibiae with several bristles; anterior tarsi (Fig. 14) with second segment a little widened below, first segment with two rather long bristles below, placed close together near base, and a minute hooked one at base of third segment, their pulvilli small; middle and hind tarsi plain; front tibiae as 21, middle ones as 45, and posterior as 50; front tarsi nearly twice as long as their tibia, hind tarsi a little longer than their tibia; segments of front tarsi as 17-8-6-5-6; of middle pair of 20-12-10-7-6; of posterior pair as 11-19-11-8-7. Calypters and halteres yellow, cilia of former black.

Wings grayish, narrowed toward the base, the posterior margin nearly evenly rounded; third and fourth veins parallel and nearly straight beyond the cross-vein, fourth ending in the apex of the wing; costa distinctly enlarged at tip of first vein; first section of fifth vein as 36, last section as 26, cross-vein as 8.

HOLOTYPE.—Male, taken at Cold Spring Harbor, Long Island, N. Y., June 22, 1931 (Curran).

This minute species would run to *caudatus* Van Duzee, from California, in the table of species in the Pan-Pacific Entomologist, VII, p. 38, couplet 15, but that species has very long yellow filaments for hypo-

pygial lamellae, the second segment of front tarsi more widened below, and *caudatus* is also larger.

***Sympycnus pectoralis*, new species**

Length, 2 mm.

MALE.—Eyes almost touching in the middle of face; face wider above, covered with grayish-white pollen; front brown pollinose; palpi and proboscis brown or yellowish brown, former more yellow toward their tips, white pollinose; first two antennal segments yellow, third brownish black (Fig. 15), longer than wide, sharply pointed at tip, arista with short pubescence; lower orbital cilia whitish.

Dorsum of thorax shining black, but in the holotype it is thickly covered with light-brown pollen; pleura mostly black on upper half, pale yellow below and with posterior edge broadly yellow. Abdomen black above and on apical segments, venter and more or less of sides of first three segments yellow; hairs on abdomen stiff and black, venter with a few longer, delicate, yellow hairs; hypopygium (Fig. 16) dark reddish-brown, its lamellae somewhat rod-like, yellowish brown with long hairs.

Coxae, femora, tibiae, and first four segments of all tarsi pale yellow, fifth tarsal segments largely black; front coxae with a few very minute white hairs and long, yellow, bristle-like hairs at tip; front femora nearly bare, having a few very short black hairs above; middle and hind femora with rather short, yellow hairs below; front tibiae without bristles, but with a row of black hairs on upper posterior edge, which increase in length and are almost bristle-like on apical part but scarcely as long as diameter of tibia; middle tibiae with two bristles above, one small bristle at basal fourth and one near apical fourth; below with one very small bristle beyond apical fourth and three large bristles at tip; hind tibiae with several small bristles above; all tarsi plain, except that front and middle tarsi have fifth segment slightly widened; length of front tibiae as 38, middle as 59, and posterior as 80; all pulvilli very small; segments of front tarsi as 21-9-8-5-5; of middle pair 34-13-10-6-5; posterior pair as 16-22-14-8-6. Calypters, their cilia and the halteres pale yellow.

Wings grayish, narrow, much narrowed at base; third vein nearly straight; last section of fourth vein slightly bent near basal sixth, beyond this bend parallel with third, ending in the apex of the wing; cross-vein situated beyond the middle of the wing, its length as 11, first section of fifth vein as 57, last section as 21 and nearly straight.

FEMALE.—Face wider, white pollinose; front sometimes shining, a little violet at vertex; first two antennal segments yellowish brown; acrostical bristles long, in a single row; anterior coxae with longer hair than in the male, wings wider, especially at base; otherwise as in the male.

TYPES.—Described from three males and four females, all taken at Cold Spring Harbor, between June 24 and July 5, 1931 (Curran).

Sympycnus pectoralis is like *inequalis* Van Duzee, from California, except that *inequalis* has the posterior edge of the pleura black, middle and hind tibiae and upper surface of hind femora brownish, and hind tibiae more brown and slightly enlarged at tip. Otherwise the two forms are much alike in color and size.

***Sympycnus pallidimanus*, new species**

Length, 4 mm.

MALE.—Face narrow, linear, silvery white; palpi and proboscis black, the former small; front blue on the sides nearly opaque with white pollen when viewed obliquely, ocellar tubercle blackish; first two antennal segments yellow, third brown, small; arista dorsal, appearing whitish against a dark background; lower orbital cilia white.

Dorsum of thorax and the scutellum bright shining green; pleura black with posterior edge narrowly yellow for most of its height. Abdomen metallic black, first segment mostly yellow, second and third segments yellow with a moderately wide anterior margin black; venter yellow; hairs of the abdomen black; hypopygium small and with rather small appendages.

All coxae, femora and tibiae wholly yellow; anterior coxae with black hairs and two curved bristles at tip; front tarsi (Fig. 17) wholly pale yellow, first segment with about ten hair-like bristles below, which end at apical third and are about as long as the diameter of the segment, fifth segment a little widened and darker yellow; pulvilli about as large as fifth segment; front tibiae with a row of long hairs on both upper and lower edge of posterior surface; middle femora with long, slender, black hairs on lower surface and on posterior surface of basal half; four long slender bristles near tip on lower posterior edge; middle tibiae with two bristles on upper surface, one just before basal third and one beyond the middle, also one above at tip; middle tarsi plain, mostly yellow; hind tibiae darker toward tip with many bristles above, which are not much longer than diameter of tibiae; hind femora with long black hair below, which become bristle-like toward the tip; hind tarsi wholly black, plain; length of front tibiae as 58, of middle pair as 76; segments of front tarsi as 30-18-12-7-6; of middle pair 38-20-17-10-7; and of posterior pair as 20-31-20-13-8. Calypters and halteres yellow, cilia of the former black.

Wings grayish, slightly darker in front; third vein a little bent back at tip; last section of fourth vein slightly arched at its middle, widely separated from third, the apex of the wing lying between their tips; last section of fifth vein as 34, cross-vein as 22; wings not narrowed at base, the anal angle being very prominent.

HOLOTYPE.—Male, Bello Horizonte, Brazil.

This form belongs to the *difficilis-spinitarsus* group, but is remarkable for the yellow hind tibiae and their wholly black tarsi, slender, and wholly yellow front tarsi, with the slender bristle-like hairs on the first segment, the remarkably prominent anal angle of the wing and the widely separated third and fourth veins.

***Kophosoma exiguus*, new species**

Length, 1.6 mm.

MALE.—Eyes contiguous in the middle of the face, the triangles above and below black; palpi dark reddish brown; proboscis black; front blue-green with brown pollen; antennae (Fig. 18) black, small, pubescent, pointed at tip, arista inserted near the middle of third segment, nearly bare; orbital cilia wholly black.

Dorsum of thorax blue-green, sides and the scutellum bronze-green; acrostical bristles in a single row, rather long; five dorsocentral bristles; pleura black, gray

pollinose. Abdomen green with bronze reflections, long pale hairs on the sides and black hairs on the dorsum; hypopygium rather small for the genus, black, yellow at tip and with pale yellow appendages, outer pair rather long, curved and a little enlarged at tip.

Front coxae yellow, very narrowly black at base, with a few black hairs on anterior surface and black bristles at tip, two on outer edge near tip very slender and as long as second segment of front tarsi; middle and hind coxae pale yellow, the middle pair scarcely infuscated on outer surface, even at base; femora and tibiae wholly pale yellow; all tibiae without bristles on lower surface, except that middle and hind ones have two rows of bristle-like hairs below, which are not much shorter than their diameter; front tibiae above with two small bristles, one beyond basal third and one at apical fifth, and a row of stiff hairs on upper posterior edge; middle tibiae with one long bristle above before basal third and another before apical third; hind tibiae with two pairs of bristles above, one pair before basal fourth and one beyond the middle; front tarsi yellow at base, almost black from tip of first segment which has a row of stout black hairs on lower surface at anterior edge, these hairs as long as the diameter of the segment and continued on the following segments, becoming shorter; middle and hind tarsi plain, yellowish, darker toward their tips, posterior ones appearing quite black because of the abundant and very black hair; length of front tibiae as 39, of middle ones as 51, and of posterior pair as 61; segments of front tarsi as 22-11-6-7-7; of middle pair as 29-17-12-9-7; of posterior pair as 15-23-16-11-10. Calypters yellow, broadly black at tip, with black cilia, several of which appear yellowish; halteres yellow.

Wings grayish; last section of fourth vein and the third vein nearly straight and very slightly divergent beyond the cross-vein, fourth ending back of the apex of the wing. Last section of fifth vein straight, its length as 22, cross-vein as 10; sixth vein represented by a slight fold in the wing membrane.

HOLOTYPE.—Male, taken in March or April, 1931, at Moca, Guatallon, Guatemala, by J. Bequaert.

This form is almost like *brevis* Van Duzee, from northeastern America; it differs in having the hypopygium smaller, arista inserted beyond the middle of third antennal segment; the rows of stiff hairs on middle and hind tibiae are longer and bristles of front tibiae shorter.

***Neurigona bicolor*, new species**

Length, 3 mm.

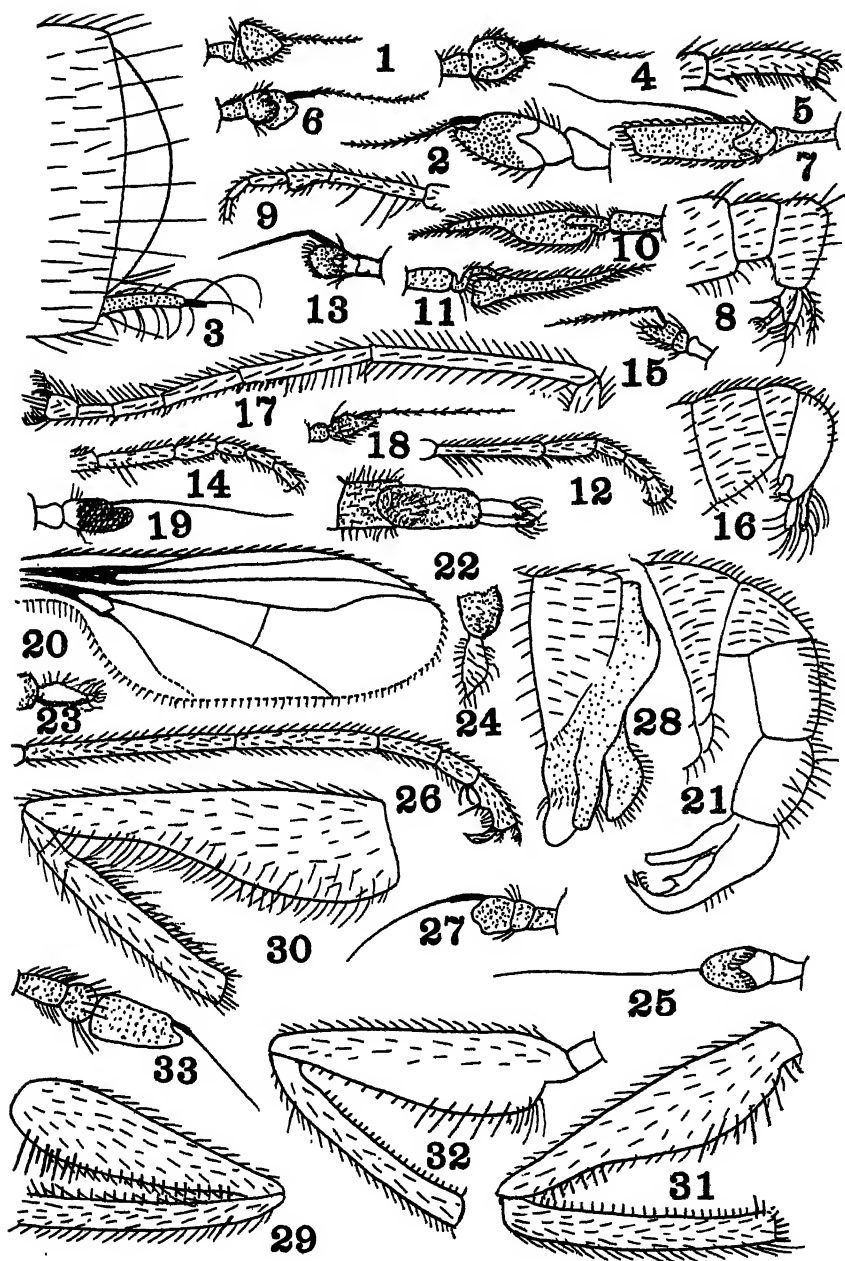
MALE.—Face narrow, its sides parallel, silvery white, lower part with a deep longitudinal depression; palpi yellow, with black hairs; proboscis bare, yellow; antennae (Fig. 19) with first two segments yellow, third black, longer than wide, rounded at tip; front and occiput greenish, with white pollen; orbital cilia white.

Thorax shining green or blue, a little dulled with white pollen, especially the depressed area in front of the scutellum; posterior edge of pleura metallic. Abdomen shining green or blue-green, dorsum of abdomen with black hair, except a few short yellow hairs on the sides; venter pale yellow, with a few very small, white hairs; hypopygium very small, mostly concealed, reddish brown, with yellowish brown, rounded lamellae, fringed with small yellow hairs.

Front coxae, femora, tibiae and tarsi wholly yellow; middle and hind coxae black with yellow tips; front coxae with a few very small yellow hairs, mostly on inner anterior edge, and two very small black bristles at tip; femora with a few small yellow hairs above, nearly bare on lower half; front tibiae without bristles; middle tibiae with a few bristles which are scarcely as long as the diameter of tibia; posterior tibiae with a row of these minute bristles above for their whole length; all basitarsi have a few very small spines below, the posterior pair also with a larger bristle below near base; length of front tibiae as 85, of middle ones as 93, and of posterior pair as 141; segments of front tarsi as 56-32-19-10-9; of middle as 94-40-21-9-8; of posterior pair as 49-39-25-12-12-10. Calypters and halteres yellow, cilia of the former white.

Wings (Fig. 20) a little grayish, only a little yellow at base, veins brown; third vein bent backward at tip; last section of fourth vein bent before its middle, the bend rounded, beyond the bend it is a little concave posteriorly; fourth vein reaching the

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- Fig. 1. *Chrysotus nigriciliatus*, new species. Antenna of male.
 Fig. 2. *Keirosoma slossonae*, new species. Antenna of male.
 Fig. 3. *Keirosoma slossonae*, new species. Hypopygium of male.
 Fig. 4. *Syntormon nubilium*, new species. Antenna of male.
 Fig. 5. *Syntormon nubilium*, new species. Hind basitarsus of male.
 Fig. 6. *Syntormon nubilium*, new species. Antenna of female.
 Fig. 7. *Parasyntormon longicornis*, new species. Antenna of male.
 Fig. 8. *Parasyntormon longicornis*, new species. Hypopygium of male.
 Fig. 9. *Parasyntormon longicornis*, new species. Front tarsi of male.
 Fig. 10. *Parasyntormon petiolatum*, new species. Antenna of male, side view.
 Fig. 11. *Parasyntormon petiolatum*, new species. Antenna of male, dorsal view.
 Fig. 12. *Parasyntormon petiolatum*, new species. Front tarsi of male.
 Fig. 13. *Sympycnus brevipes*, new species. Antenna of male.
 Fig. 14. *Sympycnus brevipes*, new species. Front tarsus of male.
 Fig. 15. *Sympycnus pectoralis*, new species. Antenna of male.
 Fig. 16. *Sympycnus pectoralis*, new species. Hypopygium of male.
 Fig. 17. *Sympycnus pallidimanus*, new species. Front tibia and tarsus of male.
 Fig. 18. *Kophosoma exiguus*, new species. Antenna of male.
 Fig. 19. *Neurigona bicolor*, new species. Antenna of male.
 Fig. 20. *Neurigona bicolor*, new species. Wing of male.
 Fig. 21. *Medetera albiciliata*, new species. Hypopygium of male.
 Fig. 22. *Thrypticus flavicornis*, new species. Hypopygium of male.
 Fig. 23. *Thrypticus flavicornis*, new species. Hypopygial lamellae of male.
 Fig. 24. *Thrypticus insulanus*, new species. Hypopygial lamellae of male.
 Fig. 25. *Coeloglutus bicoloripes*, new species. Antenna of male.
 Fig. 26. *Coeloglutus bicoloripes*, new species. Front tarsi of male.
 Fig. 27. *Hydrophorus spinosus*, new species. Antenna of male.
 Fig. 28. *Hydrophorus spinosus*, new species. Hypopygium of male.
 Fig. 29. *Hydrophorus spinosus*, new species. Front femora and tibia of male.
 Fig. 30. *Hydrophorus hirtipes*, new species. Front femora and tibia of male.
 Fig. 31. *Hydrophorus oregonensis*, new species. Front femora and tibia of male.
 Fig. 32. *Hydrophorus oregonensis*, new species. Front femora and tibia of female.
 Fig. 33. *Argyra barbipes* Van Duzee. Antenna of male.



wing margin in front of the apex of the wing; last section of fifth vein nearly straight, its length as 32, cross-vein as 14.

Types.—Holotype, male, taken in February or March, 1931, at Moca, Guatallon, Guatemala; three paratypes from the same place, in February, March, and April, all taken by Dr. J. Bequaert.

Neurigona bicolor resembles *lateralis* Say in general appearance and size, but in *lateralis* the abdomen is usually largely yellow, all coxae and posterior edge of pleura are yellow and third antennal segment largely yellow; in *bicolor* the posterior edge of pleura, middle and hind coxae and the third antennal segment are black, and the abdomen green, except sometimes a narrow yellow incisure between first and second segments.

Medetera longimana, new species

Length, 2.5 mm.; of wing, 4 mm.

MALE.—Face moderately wide, blue-green, shining; front dulled with gray pollen; palpi and proboscis shining black; antennae wholly black, third segment rounded, a very little flattened at tip, scarcely longer than wide, arista apical; lateral and inferior orbital cilia whitish.

Dorsum of thorax shining, bronze-brown, with two white pollinose stripes which are narrow in front of the large posterior depression, leaving between them a shining stripe of the ground-color, which is very narrow on the depression, but reaches the scutellum, also another pair of short white pollinose stripes, starting over the root of the wing, and not reaching more than halfway to front of thorax, all these pollinose stripes unite on the posterior depression, covering the posterior part of the thorax and the scutellum, only separated by the very narrow median line; acrostical bristles in two rows, reaching from the front of thorax to the depressed area; scutellum with two pairs of large marginal bristles; pleura black, with blue-green reflections; abdomen colored like the pleura, its hairs yellowish; hypopygium sessile, black, with a few yellow hairs; propleura with two large black bristles above each front coxa.

Coxae and femora brown or yellowish brown, anterior coxae with a few small white hairs; femora broadly yellow at apex, their hair white; all tibiae and tarsi yellow, tarsi brown toward their tips; anterior and posterior tibiae without bristles; middle tibiae with one short bristle near basal third; length of front tibiae as 36, of middle as 41; segments of front tarsi as 30-28-16-9-7, front tarsi one and one-half times as long as their tibiae; segments of middle tarsi as 51-33-19-9-7; of posterior pair as 23-54-24-12-7, the second segment being two and one-third times as long as first. Calypters and halteres yellow, cilia of the former white.

Wings almost hyaline; third and fourth veins as usual in the genus; last section of fifth vein as 18, cross-vein as 19; anal angle of wing not prominent, rounded off, the wing being of nearly equal width throughout.

HOLOTYPE.—Male, taken June 18, 1921, at Palo Alto, California.

This would run in the table of species in *Psyche*, XXV, p. 39, couplet 20, to *vittatus* Van Duzee. It is separated from that species by having the cross-vein slightly longer than last section of fifth vein, while in *vittatus* the last section of fifth vein is one and one-third times as long as cross-vein. It is also a larger species than *vittatus*.

***Medetera albiciliata*, new species**

Length, 3 mm.

MALE.—Face moderately wide above, narrowed below the suture, which is near its middle, upper part dull black, below shining black; front greenish, dulled with brown pollen; palpi black; antennae wholly black, third segment rounded, as long as wide, with a slight notch below the middle of apical margin where the arista is inserted; lower orbital cilia dark yellowish.

Thorax green, dorsum dulled with gray pollen; scutellum with two pairs of bristles, outer pair the smaller; propleura with one black bristle above front coxae and also a small black hair. Abdomen blackish green, its hair black, except on the two small apical segments, where it is yellow and short. Hypopygium (Fig. 21) long, of three segments, shining black with yellow hairs on upper part, its lamellae hook-like, black, except lower surface and at tip.

Coxae and legs black, the knees narrowly yellow; front coxae with black hair, and black bristles at tip, the hairs near the tip with a yellowish reflection; lower surface of front femora with two rows of small yellowish hairs on basal three-fourths and two black bristles on apical fourth; middle and hind femora with two rows of longer hairs below, these hairs with a yellowish reflection in certain lights; length of anterior tibiae as 40, middle pair as 56; segments of anterior tarsi as 24-15-9-5-6; of middle pair as 32-17-8-4-3; of posterior pair as 18-38-20-8-7. Calypters and their cilia yellow; knobs of halteres pale yellow, their stem brown.

Wings a little grayish, veins blackish brown, venation as usual in the genus; last section of fifth vein as 33, cross-vein as 13.

HOLOTYPE.—Male, taken by C. H. Curran, August 18, 1930, at Arnprior, Ontario.

Albiciliata is near *venatus* Curran, described from New York State, but that species has last section of fifth vein one and one-half times as long as the cross-vein, while this has the last section of fifth vein over two and one-half times as long as the cross-vein.

***Thrypticus flavicornis*, new species**

Length, 2 mm.

MALE.—Face narrow, a little wider above; face and front violet, ocellar tubercle wanting or very small, a single ocellus outside of each ocellar bristle; palpi and proboscis black; antennae small, yellow, all segments of nearly equal length, third a little flattened at tip; arista apical, black, but appearing yellowish in certain lights; bristles of the head, hairs and bristles of thorax and abdomen, and hairs of legs yellow; orbital cilia whitish, bristles of thorax appearing blackish in certain lights.

Thorax shining green, scutellum blue; abdomen shining black; hypopygium (Fig. 22) black, sessile, rounded at both ends and of nearly equal width throughout, its lamellae (Fig. 23) pale yellow, pointed at tip, half as long as hypopygium, seen from above slightly blackened on the edges at tip, its hairs very delicate and yellow.

Front coxae wholly pale yellow, middle and hind ones black, hind pair narrowly, middle pair widely yellow at tip; all femora, tibia, and tarsi wholly pale yellow; femora with the hair above and below of nearly equal length, middle and hind tibiae with a slender black bristle at tip and middle tibiae with a rather long black bristle

near the base in front; all tarsi plain, not darker at tip, last segment of front pair not or scarcely widened; length of anterior tibiae as 32, middle as 37, and hind as 48; segments of front tarsi as 14-7-5-4-6; middle pair as 18-11-8-5-5; of posterior pair as 10-14-9-7-5. Calypters and halteres pale yellow, cilia of former white.

Wings nearly hyaline; costa and veins yellow; third and fourth veins parallel, slightly arched, the fourth ending in the apex of the wing; hairs on the costa yellow, except between the tips of first and second veins, where they are black; cross-vein situated at the middle of the wing, its length as 8; first section of fifth vein as 30, last section as 21.

HOLOTYPE.—Male, taken between July 12-17, 1920, at Puerto Bermudez, Rio Pichis, Peru.

This species differs from *parvulus* Van Duzee, from the West Indies, and *penicillatus* Van Duzee, taken in Argentina, in having the middle and hind coxae black with yellow tips, the others having all the coxae yellow, but they may have their base very slightly blackened; *parvulus* also differs in having the hypopygium petiolate; *penicillatus* differs greatly from this species in the form of the hypopygium, and in having the last section of fifth vein two and one-half times as long as the cross-vein, while in *flavicornis* it is about two and two-thirds as long.

Thrypticus insulanus, new species

Length, 2 mm.

MALE.—Face wider than in *flavicornis*, otherwise the head-parts in form and color as in that species; bristles of head and thorax appearing more black in certain lights; hairs on anterior part of thorax longer, more delicate, but not as numerous; thorax, scutellum and abdomen green, rather dull; hypopygium reddish brown, formed about as in *flavicornis*, its lamellae (Fig. 24) wholly pale yellow, formed as in *flavicornis*, except that they are only one-third as long as hypopygium and have the outer surface hairy (I can see no hairs on the surface of the lamellae of *flavicornis*). Coxae, legs, and tarsi formed and colored about as in *flavicornis*, except that the last segment of front tarsi is distinctly widened and brownish and the first two segments of hind tarsi are as 13-15; all tibiae with a black bristle or spur at tip. The cilia of the calypters appear to be black. Wings crumpled; wing-veins and hairs on costa colored as in *flavicornis*.

HOLOTYPE.—St. Lucia, Windward Islands, September, 1919.

The most of the characters used are nearly like *flavicornis*, with which I have compared it.

It has the ocellar tubercle wanting, the ocellar bristles large and far apart with a single ocellus outside of each bristle, about as in *flavicornis*. The scutellum and abdomen are green in this, like the dorsum of the thorax; the hairs on the front of the thorax are more slender, longer and not as numerous, the last segment of front tarsi wider and more brown, first two segments of hind tarsi of nearer equal length; the hypopygium is more reddish on apical half and the face wider.

Coeloglutus bicoloripes, new species

Length, 4 mm.; of wing, 3.5 mm.

MALE.—Face very narrow, eyes almost touching in the middle of the face; face long, grayish white pollinose, sometimes the green ground-color showing through a little on lower part; front green, thickly covered with gray pollen; occiput blue-green with thin gray pollen; palpi yellow, with black hairs; proboscis black; antennae (Fig. 25) with first two segments pale yellow, third wholly black, rounded at tip, with long, slender, nearly bare arista; second segment overlapping third on inner side; orbital cilia apparently yellowish, the few hairs forming the beard yellowish white.

Dorsum of thorax green, with two shining green stripes, one on each side of a darker, somewhat brown, median stripe, which extends more or less distinctly to the scutellum; acrostical bristles in two rows which diverge before reaching the depressed area in front of the scutellum, this depressed area reaches fully half the length of the thorax. I can see but three pairs of dorsocentral bristles, situated on the posterior half of the thorax, the front of the dorsum of the thorax on the outside of the green stripes is thickly covered with little black hairs from the front to the root of the wings; scutellum more blue than the thorax and with one pair of marginal bristles; pleura black, white pruinose, upper edge with two green stripes, separated by a darker one, running from the wing to the front of the thorax, these green stripes covered with yellow pollen when seen from in front. Abdomen green, cylindrical, thinly covered with white pollen; hairs on the dorsum black, on the sides yellowish; venter yellow at base. Hypopygium black, mostly concealed, its lamellae brown, with yellow edge and white hairs.

Front coxae very long, wholly yellow, anterior surface with small black hairs, on the outer anterior edge the hairs are large and bristle-like, at tip is a row of five moderately large bristles; middle and hind coxae black, of about the usual length; posterior pair with one large black bristle on outer surface; front and middle trochanters yellow, hind trochanters and extreme base of femora brown; all femora and front tibiae yellow, extreme tip of latter black; middle and hind tibiae yellow on basal half, black on apical half; all femora with rather short hair below, posterior pair with long bristle-like hairs above on basal half; no preapical bristles on the femora; front tibiae without bristles; middle tibiae with one bristle below near base and one above beyond the middle; hind tibiae with a number of small bristles or spines; front tarsi (Fig. 26) yellow, with the apical segments black, last two segments modified to form a grasping organ and with one claw enlarged, the fourth segment with two hooked bristles at tip, fifth with a projection below before its middle on which is one long straight bristle; first segment of middle tarsi yellow, its extreme tip and the following segments black; hind tarsi wholly black; length of front coxae as 54, of femora as 66, and of tibiae as 81; length of middle tibiae as 92 and of posterior as 100; segments of front tarsi as 55-33-15-9-10; of middle pair as 53-28-20-9-7; of posterior pair as 29-34-19-10-8. Calypters and halteres pale yellow, cilia of former white.

Wings long and narrow, rounded at apex, grayish, brownish in front; cross-vein situated at the middle of the wing; third vein gradually and but little bent backward at tip; last section of fourth vein bent near its middle, then running straight to wing margin, its tip near tip of third vein and in front of the apex of the wing; last section of fifth vein nearly straight, its length as 42, cross-vein as 11.

Types.—Described from three males. Holotype, male, and one paratype were taken in March or April, 1931, at Moca, Guatalon, Guatemala, and one paratype taken in March or April, 1931, at Sa Adelaide, Guatalon, Guatemala, all collected by Dr. J. Bequaert.

This is the second species of the genus to be described, so far as I know. The type of the genus is *concavus* Aldrich, taken at St. Vincent Island, West Indies; that species is only 2.3 mm. long, having all coxae yellow, middle tibiae yellow with tip a little black and hind tibiae yellow, black on apical fourth; the wings a little pointed at tip and fourth vein ending in the point of the wing.

The following remarks on the genus may be of some help now that a male has been found, even if it is not the type species.

The distinguishing characters of the genus seem to be: arista apical or subapical, first antennal segment bare; second antennal segment overlapping third on inner side; the face long and narrow; elongated thorax with posterior part having a depressed area before the scutellum, which reaches nearly to the middle of the thorax; the wings and middle and hind coxae placed close together at posterior part of thorax and far removed from front coxae, which are remarkably long; abdomen of the male cylindrical, of the female of *concavus* Aldrich, depressed; hypopygium of male small, half concealed; acrostical bristles in two rows; a large area of little hairs on each side of the dorsum of the thorax; and the general form and venation of the wings, except that one species has the wings a little pointed at tip, the other with the tip rounded. All these characters are common to the generic type species *concavus* Aldrich and the present species.

Dr. Aldrich put the genus in the Medeterinae, but Dr. Becker places it in the Diaphorinae, where I think it should go now that a male has been found; the abdomen is formed as in that tribe. Perhaps a separate tribe should be made for it, as it has many singular characters.

***Hydrophorus spinosus*, new species**

Length, 3–3.2 mm.; of wing, 4–4.5 mm.

MALE.—Face green, dulled with yellowish pollen, lower part nearly opaque with yellowish pollen, about as long as wide, rounded below; front opaque brown; occiput green with whitish pollen; palpi black, with black hair, a few pale ones among them, and with white pollen; proboscis black, with white pollen on the edge; cheeks very wide, lobe-like; antennae (Fig. 27) black, rounded at tip, rather small; the black orbital cilia descend nearly to lower fourth of the eyes; beard yellow, moderately long and somewhat abundant; several black bristles under the neck.

Dorsum of thorax brown, a little metallic, with brown pollen; acrostical bristles very small, black, in a single row; two rather large humeral bristles; prothorax with one black bristle above front coxae and several yellow hairs and bristles; scutellum a

little greenish, with two pairs of large marginal bristles. Abdomen green, blue or metallic brown, dorsum with brown pollen and black hair, sides with white pollen and small white hairs; hypopygium (Fig. 28) conspicuous, black, shining black on the sides, appendages black with the ball-like tip of the inner ones yellow.

Anterior coxae and all femora and tibiae green; anterior coxae with yellowish pollen, their front surface with delicate, yellowish white hairs, on upper edge with longer yellow hair and a row of black, hair-like bristles, several near the base longer than the others, about fourteen bristles in the row; middle and hind coxae black, with white pollen; tarsi black with yellowish pollen; anterior femora (Fig. 29) thickened at base, tapering to their tip, below with five long spines on posterior side of basal fourth, and on the anterior edge a row of spines reaching their whole length (these are very short on most of their length, but three or four at base and tip a little longer); anterior tibiae (Fig. 29) with a row of short spines on inner side; posterior surface of both tibiae and basitarsi with long yellow hair on most of their length; segments of front tarsi as 35-30-15-10-16; middle pair as 42-25-17-11-16; of posterior pair as 46-30-22-13-14. Calypters and halteres wholly yellow, cilia of the former short, white.

Wings gray; veins dark brown, not paler at base of wing; third vein much bent back apically; last section of fourth vein nearly straight, only bent backward a little at the middle; middle of last section of fourth vein and the cross-vein with a large brown spot; length of cross-vein as 22, of last section of fifth vein 18; apex of wing lying between the tips of third and fourth veins.

FEMALE.—Length, 3.2-3.5 mm.; of wing, 4.5-5 mm. Like the male in the form of the front femora and its spines; the first tibiae and basitarsi have the same yellow hair on posterior surface and the wing characters about the same as in the male.

Types.—Described from thirty males and twenty five females, all taken by J. Willecox, March 9-31, 1930, at Boiler Bay, Lincoln Co., Oregon; holotype male, and allotype female, taken on March 9, 1930.

Hydrophorus spinosus differs from *viridifacies* Van Duzee, from Alaska, in having a row of about fourteen black bristles on anterior coxae, yellow pollen on the face and the hypopygium very conspicuous; *viridifacies*, which seems to come nearest this form, has only one black bristle on anterior coxae, white pollen on the face, and the hypopygium mostly concealed; they also differ in the spines on the front tibiae and femora.

***Hydrophorus hirtipes*, new species**

Length, 3-3.7 mm.; of wings, 4-4.3 mm.

MALE.—Face wide below, narrower above, upper part green, concave, with five brown lines showing when viewed from in front, a little dulled with yellowish pollen, lower part opaque with pale yellow pollen, rounded below; palpi black, their hair black with a few pale hairs among them; proboscis black; front opaque brown; occiput green with a little pollen; one pair of postvertical bristles; antennae black, about as in figure 27; the black orbital cilia reach down to lower fourth of the eye, and there are one or two black bristles in the same line, opposite lower margin of eye; beard pale yellow, rather long, but not abundant.

Dorsum of thorax shining metallic black with a little brown pollen; pleura green, with white pollen; acrostical bristles rather long, in two rows about seven dorso-central bristles in each row; scutellum with two pairs of large marginal bristles; two humeral bristles; prothorax with one large black bristle and several long yellow hairs above each front coxae. Abdomen dark greenish or bluish, with brown pollen and black hair on the dorsum, white pollen and white hair on the sides; hypopygium and its appendages mostly concealed.

Front coxae and all femora and tibiae greenish, tarsi black or brown; front coxae with moderately long, pale yellow hair on anterior surface and one small black bristle at tip; anterior femora (Fig. 30) thick at base, with long, wavy, pale yellow hair below and about six short black spines on second fourth of lower posterior surface; front tibiae with a row of short spines on inner surface, which also have long pale yellow hair on their whole length, on upper surface with moderately long, pale yellow hair, which is a little shorter than that below, and with one black bristle at basal fourth on upper posterior surface; middle and hind femora each with two bristles near apical fourth of lower anterior surface; middle tibiae with three bristles above on basal two-thirds and one on basal fourth of anterior surface; hind tibiae with six bristles above and one on anterior surface beyond apical third; length of anterior tibiae as 52, middle as 108, and posterior as 93; segments of front tarsi as 24-12-13-10-10; of middle pair as 40-23-17-16-14; of posterior pair as 40-27-21-13-12. Calypters, their cilia and the halteres pale yellow.

Wings dark grayish with conspicuous brown spots on the cross-vein and the middle of last section of fourth vein; third vein bent a little backward toward tip; last section of fourth vein bent a little before its middle, but running forward a little from the cross-vein to the tip; apex of wing lying between the tips of third and fourth veins; last section of fifth vein at quite a steep angle with basal part of fifth vein, its length as 19, cross-vein as 22.

Types.—Described from four males, taken by W. J. Brown, in August, 1930, at Quebec; holotype male and two paratypes on Thunder River, August 19, and one paratype on the Bradore Bay, August 8. Type in Canadian National Collection; paratypes in American Museum of Natural History.

Four North American species which are very much alike, having brown spots on the veins, one black bristle above front coxae, yellow halteres and four large marginal bristles on the scutellum, may be separated by the following table.

- 1.—Front coxae with long yellow hair on anterior surface. 2.
Front coxae with rather short white or yellowish white hair on anterior surface. . . 3.
- 2.—Hairs on anterior coxae deep yellow, long, stiff and very abundant; cheeks almost invisible (Alaska) *flavivirtus* Van Duzee.
Hairs on anterior coxae pale yellow, moderately long, not stiff or abundant; cheeks rather narrow, but distinctly visible (Quebec) *hirtipes*, n. sp.
- 3.—Front coxae with one black bristle near the tip (Alaska) *viridifacies*. Van Duzee.
Front coxae with a row of fourteen black, hair-like bristles on outer anterior edge, several of which at base are longer, also some longer yellow hairs on outer anterior edge (Oregon) *spinusus*, n. sp.

***Hydrophorus oregonensis*, new species**

Length, 3.3 mm.; of wing, 4 mm.

MALE.—Face green, seen from below wholly covered with yellowish-brown pollen, seen from in front the ground color shows through the pollen on upper part; cheeks about as in the female, except that they are white pollinose.

Hypopygium moderately conspicuous, its appendages without special characters that I can make out.

Front femora (Fig. 31) with six blunt bristles on basal third of lower posterior edge and six smaller spines on apical third; lower anterior edge apparently wholly without spines; front tibiae with long bristle-like hairs above, which are scarcely as long as width of tibia, below with small spines on their whole length, the two apical ones a little longer; front coxae with yellow hair on anterior surface and two small black bristles at tip, the yellow hairs on outer anterior edge long, especially at base, where they are long and bristle-like.

FEMALE.—Length, 3.5 mm.; of wing, 5 mm. Face wide, wholly covered with yellowish-brown pollen, the green ground color slightly visible on upper part in certain lights; palpi covered with similar pollen, their hairs partly yellow and partly black; occiput covered with yellowish-brown pollen, the pollen of the front darker brown; cheeks wide, lobe-like with grayish pollen, about as long as the palpi; one pair of postvertical bristles; about nine black orbital cilia on each side, reaching down to about upper third of the eye; beard yellow, long, moderately abundant; several black bristles under the neck.

Dorsum of thorax metallic brown, almost blackish, quite shining, but dulled a little with yellowish-brown pollen; humeri with a round spot of white pollen and two bristles. Prothorax with long, bristle-like hairs above anterior coxae (I cannot see any black bristle among the yellow hairs); acrostical bristles black, moderately long; scutellum with two pairs of large marginal bristles; pleura with yellowish pollen, posterior edge and the black middle and hind coxae white pruinose; abdomen green, with gray pollen, which is more yellowish on the dorsum; hairs of the abdomen mostly yellowish white.

Front coxae, all femora and tibiae more or less green; anterior coxae with yellowish pollen, their front surface with yellow hairs, two small black bristles at tip, and on outer anterior edge there seems to be a row of very small black hairs; anterior femora (Fig. 32) moderately thickened near base, with six long black bristles on basal third of lower posterior edge, and a row of little spines on whole length of lower anterior edge, also a few long delicate yellow hairs near base; front tibiae with a row of small spines below, without a projecting angle at tip on inner side; tarsi black, last segment of front tarsi a very little widened; length of front tibiae as 60, of middle ones as 132, posterior pair as 113; segments of front tarsi as 38-16-13-8-10; of middle as 45-30-23-13-15; of posterior pair as 50-30-23-14-13. Calypters and knobs of halteres yellow, cilia of former black.

Wings grayish, front margin more or less brownish in front of third vein; a brown spot on the cross-vein and another on the middle of the last section of fourth vein, these spots sometimes faint; veins brown or black, not pale at root of wing; last section of fifth vein as 17, cross-vein as 28.

Types.—Holotype, male, and allotype, female, and one male and a female paratype were all taken by R. E. Dimick, February 23, 1930, at Boiler Bay, Lincoln Co., Oregon.

This species comes nearest *pectinipes* Van Duzee, from Alaska, but that species has the pollen of the face white; one black bristle above each front coxa; delicate white hair on front coxae, and white beard. It also differs in the form and spinulation of the front femora.

APPENDIX

Argyra berbipes Van Duzee

Proceedings of the United States National Museum, LXVI, Art. 23, p. 11, 1925.

This species was described from three males and one female, all taken in California, near San Francisco. Four more specimens are now in my hands, all taken in Lake County, California. This little species is one of the few in the genus that has but little white pollen on the thorax and abdomen; it has the thorax that brilliant green so characteristic of the genus; the antennae (Fig. 33) are remarkably hairy and bristly. I am calling attention to this character as the original description does not seem to emphasize this enough.

Dolichopus brevipilosus, new name for *Dolichopus breviciliatus* Van Duzee, American Museum Novitates, Number 599, March, 1933, page 13, figure 19, and explanation of figure on page 8. The name *Dolichopus breviciliatus* is preoccupied by *D. breviciliatus* Van Duzee, Entomological News, XLI, page 71, March, 1930.

NEW FISHES FROM THE KASAI DISTRICT OF THE BELGIAN
CONGO

BY J. T. NICHOLS AND F. R. LA MONTE

We have recently studied a collection of some twenty-seven species of fishes obtained for The American Museum of Natural History at Luluabourg on the Lulua River, a tributary of the Kasai, by Father R. Callewaert of the St. Joseph Mission, in 1932, and find three or four undescribed forms therein. These comprise a *Labeo*; a small *Barbus* which we take pleasure in naming for the veteran missionary collector; a dwarf catfish probably closely allied to one which has been described in *Eutropius*, but in our opinion of a genus recognizably distinct; and a *Clarias* with confluent vertical fins which, with two or three other such specimens already described, may be an abnormality. We are unable to make up our minds on this point and present a figure of it with a name to use as a handle for students who would investigate the matter further.

Another specimen of interest is a large *Distichodus*, 220 mm. standard length, collected at Luluabourg, August 2, 1932, and identifiable as *Distichodus langi* Nichols and Griscom, with which it has been compared, though not quite typical of that species as described. It has depth, 2.5, and 10 rows of scales between lateral line and ventral. Then there is a fine specimen of *Varicorhinus macrolepidotus* Pellegrin, 245 mm. standard length, with the same data as the above.

Labeo lugubris, new species

Figure 1

SPECIFIC CHARACTERS.—One barbel on each side, hidden under folds at the side of the mouth. Inner surface of lips with transverse plicae. Eyes superolateral. Dorsal falcate, the anterior rays produced in a sharp lobe, with 10 branched rays. Caudal peduncle about as long as deep. Scales, 35 or 36; 12 or 14 around caudal peduncle. Longest ray of dorsal about $1\frac{1}{4}$ times as long as head.

DESCRIPTION OF TYPE.—Number 12334, American Museum of Natural History; a single specimen; from Luluabourg, Kasai; collected by Father R. Callewaert.

Length to base of caudal, 240 mm.; depth in this length, 3.9; head, 3.6. Eye in head, 9; snout, 1.6; interorbital, 2.1; end of snout to end of maxillary, 2; width of mouth, including lips, 2; greatest width (head and body), 1.4; length of peduncle, 2;

its depth, 1.9; longest dorsal ray, 0.7; anal ray, 1.3; caudal lobe, 1.1; pectorals, 1.1; ventrals, 1.2. Barbel in eye, 1.4.

Dorsal, 12 (10 branched rays); anal, 8; scales, 35 or 36.

Little compressed, the back convex and the lower surfaces flat. Vent halfway between ventral axil and anal origin. Eye small, superolateral, behind middle of head. Interorbital broad and flat. Snout rather pointed, long and prominent, its end somewhat bulgy and marked off by a groove. Numerous small, horny warts on the interorbital and top and sides of snout. Mouth on the under side of head, well behind tip of snout, with extensively developed fleshy lips, the lower with a fringe of papillae in front and broader flutings behind. Lower jaw with a brownish horny edge or rim. Maxillary about to under nostrils. Gill-openings separated below by a distance equal to about $\frac{1}{2}$ the length of the head. Origin of dorsal equidistant from end of snout and anal axil. Pectorals reaching $\frac{1}{2}$ the distance to ventrals, ventrals $\frac{5}{6}$ to anal; anal (which is falcate) to caudal base, when depressed.

Color of preserved specimen, dark purple-gray. Fins slaty. Lower surface of

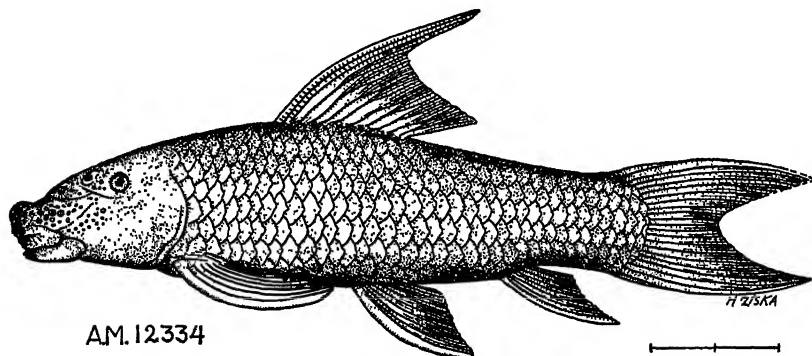


Fig. 1. *Labeo lugubris*, type.

paired fins paler proximally. The upper lip is dark and the lower surfaces and the lower lip to the anal origin are pale, yellowish or pinkish.

This form seems closest to *L. chariensis* with a series of which it has been compared. The eye is smaller, snout longer and dorsal lobe less produced. It is a somber-colored fish of very unprepossessing appearance; hence the name *lugubris*.

In the same collection is a specimen 145 mm. long, not distinguishable from *chariensis*, the only significant difference being fewer scales—32 or 33, and an exerted dorsal filament less developed, the fin having much the shape of that of *lugubris*; its longest rays 0.6 in head. It bears strong resemblances to the above larger specimen in appearance, shape of fins and color, suggesting the possibility that *lugubris* is an overgrown individual of the same thing.

***Barbus callewaerti*, new species**

Figure 2

SPECIFIC CHARACTERS.—Scales with more or less wavy and parallel, sub-horizontal striae; dorsal fin with 11 branched, and no spinous, rays; a single pair of minute barbels, less than $\frac{1}{4}$ the diameter of eye. Snout projecting well beyond mouth. Dorsal origin in advance of ventral. Lower lip confined to the corners of the mouth.

DESCRIPTION OF TYPE.—Number 12339, American Museum of Natural History; a single specimen; collected at Luluabourg; by Father R. Callewaert.

Length to base of caudal, 57 mm.; depth in this length, 3.6; head, 3.6. Eye in head, 3.6; snout, 2.7; interorbital, 3.5; maxillary, 3.4; width of body, 2; depth of peduncle, 2.1; its length, 1.8; pectoral, 1.2; ventral, 1.4; longest dorsal ray, 1.2; anal ray, 1.5; caudal lobe, 0.8. Barbel in eye, 4.5.

Dorsal, 13; anal, 7; scales, 25; 12 around peduncle.

Snout projecting well beyond the inferior, curved mouth, with numerous horny warts. Maxillary reaching to under nostril. Dorsal origin equidistant from end of snout and last third of peduncle. Upper margin of dorsal concave and lower fins all

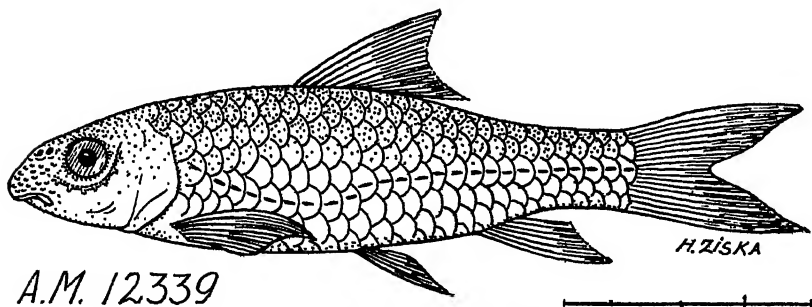


Fig. 2. *Barbus callewaerti*, type.

more or less pointed, falcate; pectoral reaching $\frac{3}{4}$ the distance to ventral, ventral $\frac{1}{2}$ to anal. Caudal well forked, with pointed lobes. Lateral line curving down somewhat over the paired fins and running straight in the center of the peduncle.

Color in preservative, purplish gray, somewhat paler below, without definite markings; the scales on back and sides more or less dark edged.

***Clarias confluentus*, new species**

Figure 3

SPECIFIC CHARACTERS.—Dorsal and anal fins broadly confluent with the caudal. Eye with a free rim. Ventral fins nearer end of snout than root of caudal by about $\frac{1}{4}$ their distance from the former. Nasal barbel about $\frac{1}{2}$ longer than head; maxillary barbel $1\frac{1}{4}$ times length of head. Head moderately granulate above; 1.4 times as long as broad; its length 4.2 in standard length. Distance between occipital process and dorsal, 4.5 in length of head. Vomerine teeth in a crescentic patch. Dorsal rays about 70; anal about 50; 18 gill-rakers on anterior arch.

DESCRIPTION OF TYPE.—Number 12340, American Museum of Natural History; collected at Luluabourg; August 23, 1932; by Father R. Callewaert.

Length to base of caudal, 147 mm.; depth in this length, 5.2; head (to end of occipital process), 4.2. Snout in head, 3.2; interorbital, 2.3; width of head, 1.2; pectoral spine, 2.2; pectoral, 1.9; ventral, 2.6; longest dorsal ray, 2.5; longest anal ray, 3; caudal, 1.9; nasal barbel, 0.8; maxillary barbel, 0.6. Eye in interorbital, 4.

Head moderately granulate above. Two conspicuous fontanels; one backward from between the eyes, and a smaller one on the base of the occipital process, which process is pointed and about as broad as long. Vomerine teeth in a crescentic band about as broad as that on the premaxillary. Gill-rakers on the first arch, 18 or 19. Maxillary barbel reaching about to ventral; nasal barbel to front of dorsal; pectoral spine serrate before and behind; ventrals reaching past front of anal by $\frac{1}{8}$ their length. Dorsal evenly confluent with caudal; anal showing a shallow reëtrance in its conjunction with that fin; last dorsal and anal rays both attached to caudal for their full length; caudal rounded.

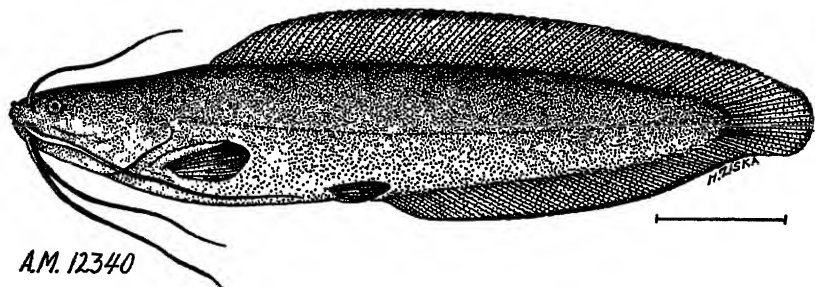


Fig. 3. *Clarias confluentus*, type.

Color dark gray, paler along the ventral surfaces. Paired fins dark and anal dark marginally.

This species is based on a single specimen which differs from other members of the genus we have seen, with the exception of *zygouron* Nichols and Griscom, 1917, in confluence of dorsal and anal with caudal fin. Its resemblance in appearance to specimens of *C. bythipogon* in the collection suggests the possibility of its being an abnormal individual of this or an allied species, though there are other slight technical details which separate it from *bythipogon*. It is unlike *zygouron*, which may equally have been based on an abnormal specimen, but of a different species. J. R. Norman (London) and G. S. Myers (Washington), in lit., are inclined to take the view that such specimens are abnormalities.

EUTROPIELLUS, new genus

Dwarf catfishes, differing from *Eutropius* in smaller size and in that they have but one pair of mandibular barbels (the outer).

Eutropius debauwi Boulenger presumably belongs to this genus, in which case Boulenger's figure is at fault in showing two pair of barbels. In any event, Mr. J. R. Norman has kindly examined for us the paratype of *debauwi* in the British Museum (Natural History) which has only one pair, as have likewise specimens so identified by Nichols and Griscom, 1917, from Avakubi, Niapu and Poko.

TYPE.—*Eutropiellus kasai*, new species.

Eutropiellus kasai, new species

Figure 4

DESCRIPTION OF TYPE.—Number 12338, American Museum of Natural History; collected at Luluabourg, Kasai; August 29, 1932; by Father R. Callewaert.

Length to base of caudal, 80 mm.; depth in this length 3.9; head, 5.6. Eye, in

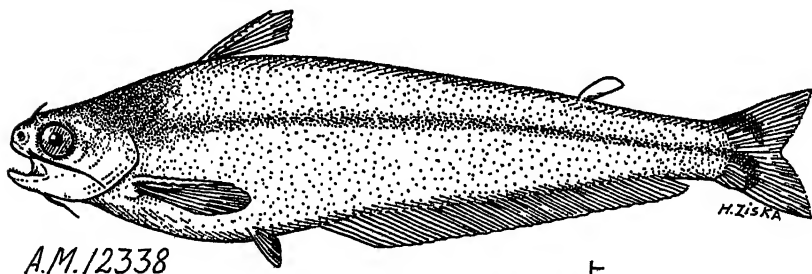


Fig. 4. *Eutropiellus kasai*, type.

head, 3.5; snout, 3; interorbital, 2; nasal barbel, 5; maxillary barbel, 1.4; mandibular, 2.3; greatest width (at back of head), 1.7; depth of peduncle, 2.2; its length, 1.9; pectoral spine, 1.2; ventral fin, 2.5; dorsal spine, 1.6; longest anal ray, 2.1; height of adipose, 3.5; caudal lobe, 1.5; base of dorsal, 6. Head in anal base, 2.6.

Dorsal rays, I, 5; anal, 49.

Snout blunt and rounded; interorbital convex; eyes large and lateral. Lower jaw appreciably included; barbels slender, thread-like. Dorsal origin about equidistant from end of snout and origin of anal; ventral origin behind base of dorsal; pectoral reaching past ventral base; ventral just to anal. Dorsal and pectoral spines slender, appreciably serrate behind; the pectoral weakly serrate in front.

Color in preservative, pale, a dark mark at the shoulder and faint dark band thence to base of caudal. A diffuse dark shade obliquely downward on the base of the upper lobe of the caudal and a diffuse blotch on the base of the lower lobe. These caudal markings are as in *Eutropius debauwi*, but less definite.

A paratype, 56 mm. standard length, has the caudal markings somewhat more definite and 47 anal rays.

This Luluabourg collection comprises 27 species allocated as follows: 1 *Polypterus*, 4 mormyrids, 4 characins, 12 catfishes, 4 carps of which 1 is a *Barbus*, 1 *Mastacembelus*, and 1 *Anabas*. In 1926 the Museum received a collection of 17 species from the same source, comprising 4 mormyrids, 1 characin, 7 catfishes, 2 carps of which 1 was a *Barbus*, 1 *Anabas*, 1 *Lates*, and 1 cichlid. Two of the catfishes occur in both collections, otherwise the species are all different, totalling 42. To get an idea of the faunal balance of the locality we may combine the two collections: 8 mormyrids, 5 characins, 17 catfishes, 2 *Barbus*, 1 cichlid, and 9 otherwise distributed. In percentages this gives 19 mormyrids, 12 characins, 40+ catfishes, 5 *Barbus*, 2+ cichlids, and 21+ otherwise distributed.

Compared with an extensive Congo collection,¹ characins are somewhat lower (perhaps because this is small stream material), 12 versus 18; cichlids lower, 2 versus 9; catfishes higher, 40 versus 27. As is to be expected, the locality is definitely in the Nile-West African faunal area. There is no approach to figures obtained for a small Angolan collection¹ in which catfishes are low, 8½ versus 40; *Barbus* and cichlids high, 41½ versus 5, and 20% versus 2. The abundance of catfishes and scarcity of cichlids are interesting if they prove to be characteristic of the Kasai district, but they may be due to chance or to local (ecological) conditions.

¹Nichols and Boulton, 1927, Amer. Museum Novitates, No. 264, p. 2.

AMERICAN MUSEUM NOVITATES

Number 657

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Sept. 8, 1933

59.9, 33 S (57.1)

A NEW SPECIES OF SHREW FROM EASTERN SIBERIA

By GEORGE G. GOODWIN¹

In a collection of small mammals made by the author in eastern Siberia during the winter of 1929 and 1930, there are series of several species of shrews. *Sorex annexus* was most abundant and no less than nine *S. unguiculatus*, two *S. araneus borealis*, and three *S. minutus gracillimus* were taken as well. A small series of two specimens of a dark-bellied *Sorex* represents a species hitherto undescribed.

Acknowledgment is due to Mr. William J. Morden and Mr. George C. Graves who arranged the expedition.

Sorex gravesi, new species

TYPE.—No. 85445, Amer. Mus. Nat. Hist.; ♀ adult; Monoma River, 80 miles east of Troitskov, Maritime Province, eastern Siberia; January 14, 1930; collector, George G. Goodwin.

GENERAL CHARACTERS.—A dark-colored shrew, about the size and external proportions of *S. araneus borealis*, but underparts dark blackish brown; tail rather short, finely haired and tufted at tip, fore and hind feet large but not nearly so large as in *S. unguiculatus*.

DESCRIPTION.—Color of back dark mummy-brown, this color extending well over crown of head, sides, and down limbs to ankles; sides barely perceptibly paler than back; underparts mummy brown, very little lighter than back; feet snuff brown; tail about color of back above, below buffy at base but gradually shading darker toward tip which is darker all around; lips and chin soiled whitish.

Skull short with broad flattened braincase, the unicuspid teeth inclined forward, tips rounded and, viewed laterally, evenly graduated in size backward. The first unicuspid is the largest, the third is as much smaller than the second as the second is than the first, and the fourth is equally as much smaller than the third; the fifth unicuspid is smallest, evenly placed in the toothrow, tipped with pigment and relatively large.

MEASUREMENTS OF THE TYPE, TAKEN IN THE FLESH.—Total length, 100 millimeters; length of tail, 35 mm.; hind foot, 15 mm. Skull, condylobasal length, 19.2 mm.; cranial breadth, 9.5 mm.; interorbital breadth, 4.1 mm.; palatal length, 8.1 mm.; maxillary breadth, 5.4 mm.; maxillary toothrow, 8.6 mm.; distance from tip of first upper incisor to back of last premolar, 5.6 mm.

Sorex gravesi may be distinguished from *unguiculatus* by its much smaller feet, finely haired and tufted tail, and dark-colored underparts.

¹Field naturalist, Morden-Graves North Asiatic Expedition.

The dentition, however, is much the same, but the skull is proportionately smaller.

Besides the type, there is one paratype which, however, is abnormal, having four unicuspid teeth on one side of the upper jaw and five on the other. Externally it agrees closely with the type. The underparts are not quite as dark as in the type but still darker than any other species of *Sorex* from eastern Siberia known to me.

The specimens were taken in low evergreen-forested country on the banks of the Monoma River which eventually flows in the lower Amur.

AMERICAN MUSEUM NOVITATES

Number 658

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Sept. 8, 1933

58.31, 2 (117:51.7)

PENNSYLVANIAN FORAMINIFERA FROM MONGOLIA¹

By J. J. GALLOWAY² AND L. ERSKINE SPOCK³

PART I

FIELD RELATIONS

By L. ERSKINE SPOCK

INTRODUCTION

The Foraminifera described in the main part of this paper were obtained from a single specimen of limestone collected from a ledge outcropping on the south side of the Tairum Nor Basin in the eastern-central part of Inner Mongolia about 64 miles in a southeasterly direction from Iren Dabasu. Its approximate position is 43° 20' N. and 113° 9' E. (See Fig. 1.) The topography of the immediate vicinity can be seen on Sheet 21 of the topographic maps shortly to be published by the American Museum of Natural History. The material was collected by the writer on a reconnaissance trip east of the Kalgan-Urga trail in 1928, but it was not known to contain fossils until later. On his return from the Expedition of 1930, Père Teilhard de Chardin⁴ reported the presence of Paleozoic Marine fossils from the same general region. This discovery led to a microscopic study of the pre-Cretaceous limestones of eastern and central Inner Mongolia and the subsequent finding of fragmentary remains of Foraminifera in the limestone of Tairum Nor. Additional thin sections revealed better-preserved material.

The limestone is compact and hard. In color it is brownish gray, intricately traversed by irregular veins of white crystalline calcite. These veins cut the rock in every direction. Only the denser portions have yielded fossils, most of it being too coarse and recrystallized.

ANCIENT LIMESTONES OF CENTRAL INNER MONGOLIA

Many outcrops of pre-Cretaceous limestone have been found in the vicinity of Tairum Nor, and adjacent parts of the Gobi. Wherever the contacts, with other rocks, are visible, they appear to be conformably enclosed between steeply dipping slates or graywackes. In general these

¹Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 116.

²Indiana University, Bloomington, Indiana.

³New York University; Geologist Central Asiatic Expeditions, 1928.

⁴Oral communication.

limestones are badly fractured, and in all but a few exceptional cases they are so thoroughly recrystallized that any fossils that may have existed originally are likely to have been destroyed.

The relation of this particular limestone to other rocks in the vicinity is not known, but similar limestones have been found at two¹ and probably at three places in alignment with this one, along the regional strike of the ancient rocks of the desert floor. Since these rocks show strong similarities in lithology and structural habit, it seems reasonable to assume that the Foraminifera-bearing limestone is a member

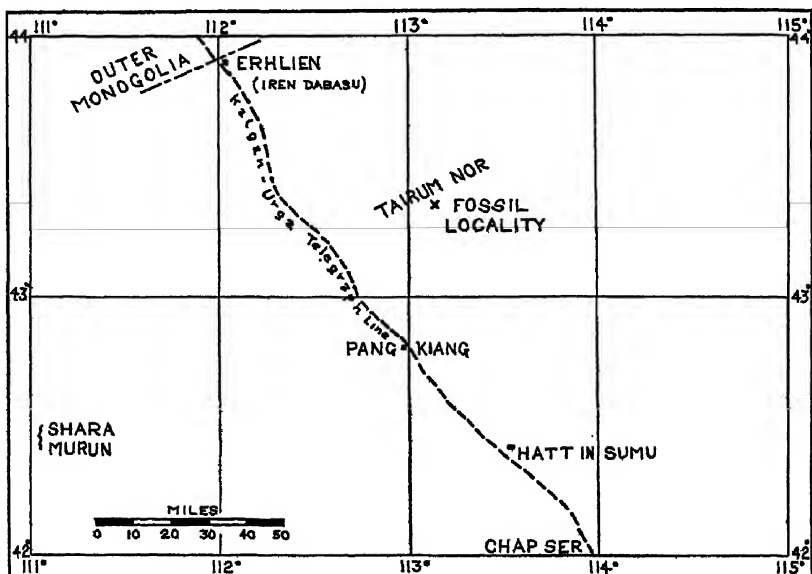


Fig. 1. Sketch map of a part of Inner Mongolia showing the position of the outcrop of limestone from which the Foraminifera were obtained.

of the slate-graywacke-limestone series which forms a large structural unit in this part of the desert. No fossils have been found in the limestones which lie along the line of strike, but their relation to the enclosing rocks can be seen. Here, as in many parts of Mongolia, the older rocks are buried below a thick cover of the "later" sediments. Exposures of pre-Cretaceous rocks are limited to basins excavated by the wind, and to hills which project up through the sediments. The rocks of the Tairum Nor region are further obscured by playa deposits and drifting sands.

¹Tailhard de Chardin, P. 1930. Oral communication.

PALEOZOIC LIMESTONES OF WESTERN MONGOLIA

In 1922, the first field season of the Central Asiatic Expeditions in Mongolia, Paleozoic strata were identified at several localities west of the Kalgan-Urga trail. Two of these are important: the Sair Usu formation,¹ of Mississippian (Dinantian) age, and the Permian beds at Jisu Honguer. Marine fossils have been collected from both formations, and those of Jisu Honguer² have already been described.

The Foraminifera described by Dr. Galloway in the following pages of this paper are of particular interest in that they establish the existence of marine rocks of Pennsylvanian age in the Gobi, and thereby add a new chapter to the Paleozoic history. Furthermore, they are the first Foraminifera collected for the American Museum by the Central Asiatic Expeditions in Mongolia.

PART II

DESCRIPTIONS OF FORAMINIFERA

BY J. J. GALLOWAY

INTRODUCTION

The rock is a gray, rather pure, hard limestone, made up of Foraminifera, Ostracoda, *Productus* spines, sponge spicules and finely comminuted fossil debris, embedded in a fine-grained, irregular, impure, calcareous groundmass. The limestone has been considerably dissolved away, making irregular cavities which have been filled with pure, coarsely crystalline calcite. It has also been much fractured, including the filled solution cavities, and the fractures have been filled with clear, coarsely crystalline calcite. There are embedded in the fossiliferous groundmass some small pebbles of very fine-grained, massive limestone, without fossils, and some rounded grains of calcite.

The fossils are well preserved, but cannot be freed from the matrix and may be studied only in thin sections.

The following Foraminifera have been identified:

Endothyra sp.

Bradyina nautiliformis Möller

Globivalvulina cf. *bulloides* Brady

Tetrataxis conica. Ehrenberg

Climacammina, n. sp.

Schubertella lata Lee and Chen

¹Berkey, C. P., and Morris, F. K. 'The Geology of Mongolia,' Nat. Hist. Central Asia, II, pp. 170-173 and 406.

²Grabau, A. W. 'The Permian of Mongolia,' Nat. Hist. Central Asia, IV.

AGE OF THE ROCK

The rock is middle Pennsylvanian, upper Moscovian in age, and very close to the horizon of the Huanglung limestone of the Lungtan area of east central China.¹ It may also be correlated with the Marmaton group of Kansas, and the Strawn group of Texas. Most of the species occur in the upper Moscovian of China, and several of them in the same horizon in Russia and North America. None of the species occurs as high as the Permian.

DESCRIPTION OF SPECIES

Endothyra sp.

Figure 2 (1 and 2)

cf. *Endothyra bowmani* LEE AND CHEN, 1930, Mem. Nat. Res. Inst. Geol., No. 9, Nov., Pl. v, fig. 14. (Moscovian, Huanglung limestone, China.)

Test minute, 0.3 to 0.6 mm. in greatest diameter, with about ten chambers in the last whorl; the plane of coiling swings through 30° to 90° from the early stage to the adult; wall thin, 0.015 to 0.025 mm., calcareous, finely granular or transversely fibrous, not composed of agglutinated, foreign particles. Abundant.

There are two species, a larger and a smaller one. Neither is probably the same as *E. bowmani* Phillips, from the Lower Carboniferous of England, which is planispiral throughout, according to the original figure. They are more similar to several described species from the Pennsylvanian of Kansas, Oklahoma and Texas, and the form figured by Lee and Chen. The species cannot be identified from thin sections, which do not show the aperture.

Bradyina nautiliformis Möller

Figure 2 (3 and 4)

Bradyina nautiliformis MÖLLER, 1878, Mém. Acad. Sci. St. Pétersbourg, Ser. 7, Vol. 25, No. 9, p. 93, Pl. III, fig. 4; Pl. x, fig. 3. (Moscovian, Russia.) LEE, J. S., CHEN, S., AND CHU, S., 1930, Mem. Nat. Res. Inst. Geol., No. 9, Nov., p. 104, Pl. v, figs. 5-9 (Moscovian, Huanglung limestone, China.)

Test of medium size, 1.6 mm. in greatest diameter, 1 mm. in shorter diameter, nautiloid, planispirally coiled in the adult, the plane of coiling swinging through about 30° from the young to the adult stage; six chambers in the last whorl; a thin, secondary septum extends inward from the posterior part of the chamber and joins with the preceding septum; wall up to 0.12 mm. thick, calcareous, not arenaceous, consisting of a thin tectum and thick keriotheca, in which are occasional large, round grains of calcite; aperture not observed. Common.

This form seems to be identical in all respects with the Moscovian ones from Russia and China.

¹Lee, J. S., Chen, S., and Chu, S. 1930. Mem. Nat. Res. Inst. Geol., No. 9, November, p. 85.

Globivalvulina cf. bulloides Brady

Figure 2 (5)

Valvulina bulloides BRADY, 1876, Pal. Soc. Mono., p. 89, Pl. iv, figs. 12-15. (Upper Pennsylvanian, Iowa.)

Globivalvulina bulloides GALLOWAY AND RYNIKER, 1930, Oklahoma Geol. Surv., Circ. No. 21, p. 16, Pl. III, fig. 1. (Lower Pennsylvanian, Oklahoma.)

Test small, 0.3 mm. in greatest diameter; chambers rapidly enlarging, the last nearly as large as all preceding; wall thin, about 0.013 mm., calcareous, finely granular. Rare.

Tetrataxis conica Ehrenberg

Figure 2 (6)

Tetrataxis conica EHRENBURG, 1843, Bericht. k. preuss. Ak. Wiss. Berlin, p. 106; Mikrogeologie, 1854, Pl. xxxvii, Pt. 11, fig. 12. (Moscovian, Russia.) MÖLLER, 1879, Mém. Acad. Imp. Sci. St. Pétersbourg, Ser. 7, No. 5, p. 71, Pl. II, fig. 3; Pl. VII, figs. 1, 2. (Moscovian, Russia.) LEE, J. S., CHEN, S., AND CHU, S., 1930, Mem. Nat. Res. Inst. Geol., No. 9, Nov., p. 90, Pl. III, fig. 1. (Moscovian, Huanglung limestone, China.)

Test small, 0.6 mm. high and 0.82 mm. wide at the base, with rounded apex; chambers inflated downward; wall thick, consisting of a thin, dark, upper layer and a thicker, transparent, fibrous lower layer. The section probably does not cut through the apex and the axis of the test. This form is very similar to those found in the Moscovian of Russia and China.

Glimacammmina, n. sp.

Figure 2 (7)

cf. *Cribrostomum eximium* LEE AND CHEN, 1930, Mem. Nat. Res. Inst. Geol., No. 9, Nov., p. 100, Pl. IV, fig. 9. (Moscovian, Huanglung limestone, China.)

Test large, conical, slender, 2.6 mm. long, 1 mm. wide at the apertural end, composed of eight or nine pairs of chambers arranged biserially, followed by two or three uniserial chambers; wall thick, dark, with thin, transparent streaks parallel to the wall; aperture cribrate in the uniserial chambers.

This form seems to be identical with the one described by Lee and Chen. It is not a *Cribrostomum*, however, which is biserial throughout. Neither is it *Textularia eximia* Eichwald, which is biserial, with a single, slit-like aperture.

Schubertella lata Lee and Chen

Figure 2 (8)

Schubertella lata LEE AND CHEN, 1930, Mem. Nat. Res. Inst. Geol., No. 9, Nov., p. 111, Pl. VI, figs. 9-11. (Moscovian, Huanglung limestone, China.)

Test minute, ovoid, 0.6 mm. in axial diameter and 0.4 mm. in median diameter; proloculum 0.08 mm. in diameter; nucleocoenchothyroid, at right angles to the adult whorls, consisting of one whorl of eight chambers; wall thin, 0.015 mm., consisting of a single, very finely granular, but not arenaceous, layer; septa not fluted; chomata scarcely discernible.

This is the only species of the Fusulinidae seen in the limestone. It seems to be identical with the Moscovian form from China.

SPINES OF *PRODUCTUS*

Figure 2 (9)

The limestone contains large numbers of round, elliptical and tubular structures, varying in diameter from 0.08 to 0.3 mm., which originally were hollow. The walls are either finely granular or transversely fibrous and alveolar. These structures are probably not Foraminifera, but the spines of the brachiopod genus *Productus*.

Fig. 2. Microscopic section of Foraminifera from Tairum Nor, Mongolia.

(1) *Endothyra* sp. $\times 70$. Transverse section, showing 30° swing in the plane of coiling.

(2) *Endothyra* sp. $\times 70$. Median section of a smaller species, showing 90° swing in the plane of coiling.

(3, 4) *Bradyina nautiliformis* Möller. $\times 25$. 3. Median section, showing secondary septa and alveolar wall structure. 4. Transverse section, showing the proloculum, and swing in the plane of coiling.

(5) *Globivalvulina* cf. *bulloides* Brady. $\times 70$. Section parallel to the base.

(6) *Tetrataxis conica* Ehrenberg. $\times 55$. Oblique vertical section.

(7) *Climacommia*, n. sp. $\times 25$. Longitudinal section parallel to the axis, showing uniserial later chambers, with many tubular apertures.

(8) *Schubertella lata* Lee and Chen. $\times 70$. Section oblique to the axis, showing proloculum and endothyroid nucleocoach.

(9) *Productus* spines. $\times 70$. Cross sections. The three lower ones are of average size. The upper one has thick, alveolar walls, and may be a foraminifer.



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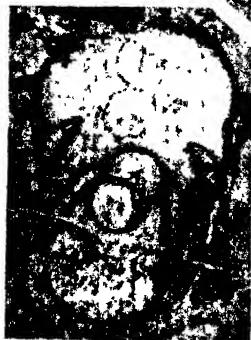
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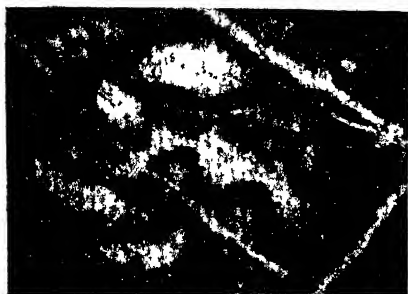
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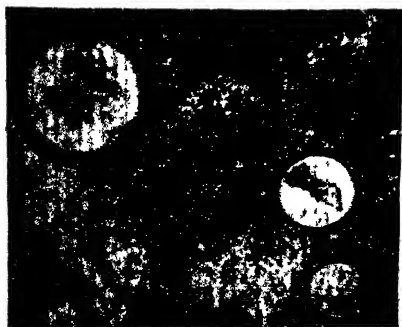
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THE DISTRIBUTION OF ROTIFERA ON MOUNT DESERT
ISLAND. PART II¹NEW NOTOMMATIDAE OF THE GENERA *NOTOMMATA* AND *PROALES*

BY FRANK J. MYERS

Some years ago, Dr. Roy W. Miner, of The American Museum of Natural History, suggested to the writer that a study of the rotifers of Mount Desert Island, Maine, should be made. Investigation was accordingly started during the summer of 1921 and continued intermittently until 1932.

Although fieldwork is still in progress, so much material had accumulated that it seemed advisable to publish a preliminary report of all known species found on the Island (Myers, 1931). The species listed in this published report included nearly all the rotifers belonging to the central group of the Notommatidae previously described by Harring and Myers (1922, 1924, 1926, 1929).

Although at the time of the completion of Part IV of the 'Rotifer Fauna of Wisconsin' (Harring and Myers, 1929), it was thought that the majority of species belonging to the genus *Notommata* and other closely related groups had been found and described, further fieldwork on Mount Desert Island revealed an entirely unsuspected wealth of new rotifers belonging to many genera. Some of these new forms are described in this paper.

It should not be assumed that all of the new species herein described are endemic in any sense of the word. Many of the new rotifers collected by the above investigators (over one hundred in all) and originally found in acid-water associations of Wisconsin and New Jersey, have since been reported from abroad, and there is no doubt that many of the species, now considered to be rare, will eventually be shown to have a world-wide distribution.

It is evident that as yet we know only a fraction of the total number of rotatorian species extant. One reason for this is that permanent associations of acid water are not common where rotifers have hitherto been searched for most intensively. Many of the now common rotifers

¹Part I (not numbered) of this work appeared in 1931, American Museum Novitates, No. 494, pp. 1-12. It comprises a faunal list of the rotifers of Mount Desert Island.

were considered rare before acid-water associations were thoroughly investigated in this country.

As the hydrogen ion concentration of large bodies of water within an acid terrain is higher in the open reaches near the middle than in the shallower littoral region where aquatic plants are abundant, most of the acid-water rotifers are to be found within the six foot contour limit among submerged aquatic vegetation or evenly distributed in the relatively small and shallow waters of permanent acid-water associations.

The p_H of twenty-seven fresh-water locations, in which collections on Mount Desert Island were made, ranged from 6.0 to 6.8, in the littoral region. In the summer of 1927, the p_H of the shore region of Long Lake, the largest body of fresh water on the Island, was 6.6-6.8, while it registered 7.0-7.2 near the middle.

Paratypes of all available material herein described have been deposited in the collection of The American Museum of Natural History. Fourteen new species described in this paper are as follows:

Notommata endoxa
Notommata aethis
Notommata avena
Notommata apochaeta
Notommata prodota
Notommata fasciola
Notommata rugosa

Proales phaeopsis
Proales adenodis
Proales ornata
Proales granulosa
Proales bemata
Proales gladia
Proales macrura

ORDER PLOIMA

Family Notommatidae

Notommata endoxa, new species

Figure 1

The body is slender and tapering; its greatest depth is about one-seventh of the total length. The integument is rather flexible, but the outline is quite constant.

The head is short and stout; there is a slight transverse skin fold just in front of the dorsal antenna, and a well-marked constriction separates the head from the abdomen. The trunk tapers gradually to the base of the toes. The tail is small and consists of one round lobe. The foot is very short and obscurely two-jointed. The toes are small and acute. From the dorsal view, they diminish suddenly from broad bases, ending in papillose tips.

The corona extends down the ventral side about one-fourth of the total length of the animal. The auricles are relatively small.

The dorsal and lateral antennae are minute setigerous papillae in the normal positions.

The mastax is of the virgate type, the trophi being robust and asymmetric. The fulcrum is long and stout, tapering gradually from the base to the posterior end. The posterior half of the fulcrum is Y-shaped in cross-section, appearing as two thin

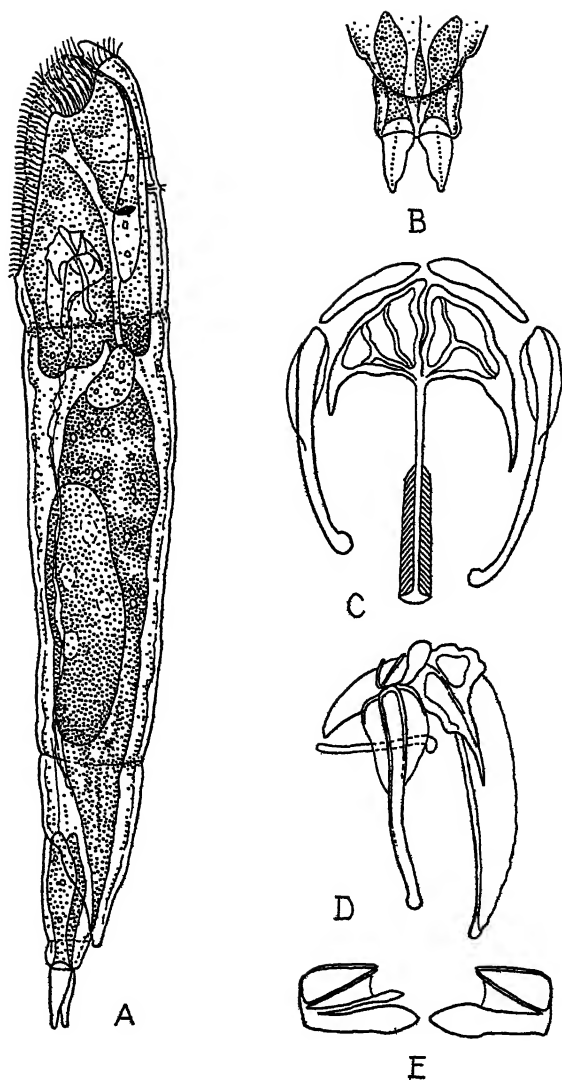


Fig. 1. *Notommata endoxa*, new species.

A, lateral view; B, toes, dorsal view; C, trophi, ventral view; D, trophi, lateral view; E, unci, frontal view.

lamellae gradually increasing in width, projecting diagonally outward, and providing increased surface for the attachment of the abductor muscles. The rami are irregularly triangular from the ventral view and are strongly curved longitudinally so that their posterior edge is nearly at a right angle with the fulcrum. The alulae are strongly developed, the left being larger than the right. The right uncus has a well-developed ventral tooth, clubbed near the tip, followed by a smaller and more slender tooth, arising from the base of the former; the basal plate is provided with two strengthening ribs. The left uncus has a very short opposing ventral tooth, followed by two strengthening ribs attached to a subsquare basal plate. The manubria are long and stout, the left manubrium being more robust and longer than the right. The lamellar basal portions are small and triangular; the posterior branches curve abruptly inward. Below the posterior edge of each ramus, a curved supporting rod is embedded in the walls of the mastax.

The gastric glands are small and reniform. The stomach and intestine are normal and the bladder is formed by an expansion of the cloaca. The foot glands are stout and slightly longer than the foot.

The retrocerebral sac is very long, and numerous bacteroids are clustered in the posterior portion. The retrocerebral duct is somewhat opaque and can be traced to the outlets on the corona. The subcerebral glands are slightly more than one-half the length of the retrocerebral sac. There is a large eyespot at the posterior end of the relatively small ganglion.

Total length, 530–650 μ ; toes, 30–40 μ ; trophi, 60 μ .

HABITAT.—Littoral fresh-water associations among submerged aquatic vegetation.

Notommata endoxa is one of the larger species of the genus. It seems to be widely distributed, although never in great numbers. It has been found sparingly on Mount Desert Island; in Polk County, Florida; Vilas County, Wisconsin; and Atlantic County, New Jersey. Its nearest relative is probably *Notommata pachyura* (Gosse). Both species have the same arrangement of the retrocerebral organs, although the sac is never clear in *Notommata endoxa*, as in the former species. The bladder is absent in both, and there is a general resemblance in the structure of the trophi. However, the shape of the body and the toes of these rotifers is quite different. A salient character of *Notommata pachyura* is the presence of a round, prominent, dorsal prolongation of the abdominal cuticle overhanging the foot, the so-called "tail." In *Notommata endoxa* this is small and normal.

Notommata aethis, new species

Figure 2

The body is very long, slender, and cylindric; its greatest depth is about one-eighth of the total length. The cuticle is very flexible, and the outline varies considerably with the state of contraction.

There is no skin fold separating the head from the abdomen; instead, there are several elevations and depressions which roughly mark the anterior and posterior limits of the intestinal tract. The head is bluntly pointed anteriorly, and the corona

is extremely long. The buccal field is evenly ciliated and projects in the region around the mouth, giving the lateral view of the corona an angular appearance. The trunk is nearly parallel-sided, being only slightly gibbous over the lumbar region, whence it diminishes gradually to a long, cylindrical portion. The foot is very short and tubular. The toes are widely separated at the base. From the dorsal view, the outer edges are straight; the inner edges are also straight for nearly their entire length, then diminish abruptly and end in papillose tips.

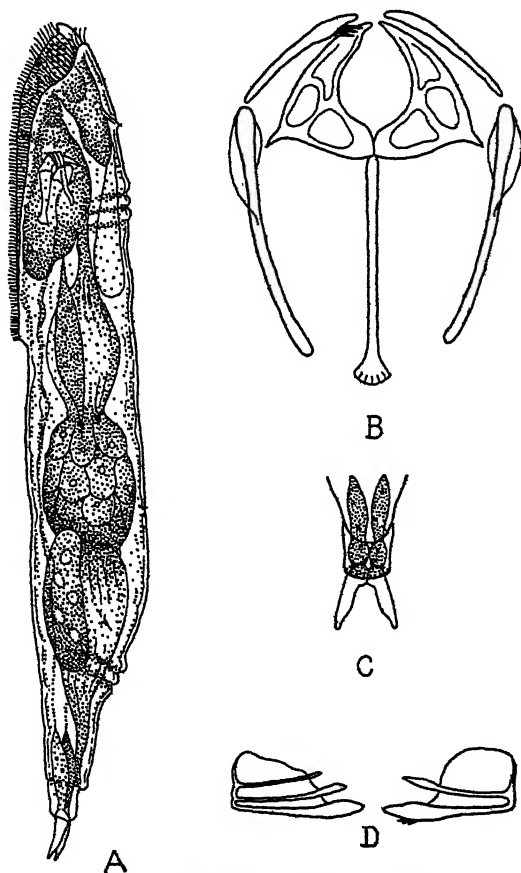


Fig. 2. *Notommata aethis*, new species.

A, lateral view; B, trophi, ventral view; C, toes, dorsal view; D, unci, frontal view.

The dorsal antenna is a minute, setigerous papilla. The lateral antennae are small tubules, from the tips of which emerge sensory seta.

The corona resembles that of the forcipate notommatis. It extends down the ventral side about two-fifths of the total length of the animal. The apical area is very

similar to the rostrum of many species of the genus *Dicranophorus*, but the ciliation of the circumapical band persists in this case. Laterally, there are two non-evertile, strongly ciliated arcs resembling auricles.

The mastax is of the virgate type. The fulcrum is long and slender, the posterior end being abruptly expanded. The rami are approximately triangular from the ventral view, and the dorsal portion is bent nearly at a right angle to the fulcrum; the inner margins are lyrate and without denticulation. The left uncus has a large ventral tooth, clubbed near the tip, to which three small, rodlike preuncial teeth are attached. The main tooth is followed, in turn, by one stout accessory. All are attached to a subsquare basal plate. The right uncus has a stout opposing ventral tooth, clubbed near the tip and followed by two more slender accessories. The manubria are broadly expanded anteriorly, the median branch continuing as a slight incurved rod.

The esophagus is very long, the posterior portion being expanded into a vast proventriculus. The gastric glands are large, elongate, and fusiform; they are attached to the wall of the mastax anteriorly and to the sides of the stomach posteriorly. The stomach and intestine are separated by a deep constriction. The ovary is small, and an expansion of the cloaca functions instead of a bladder. The foot glands extend forward for some distance beyond the foot.

The retrocerebral sac is very long and clear. There are no subcerebral glands, nor is an eyespot present.

Total length, 237–256 μ ; toes, 12–16 μ ; trophi, 25 μ .

HABITAT.—Submerged sphagnum in acid-water associations.

Notommata aethis occurs sparingly on Mount Desert Island and has also been collected in Atlantic County, New Jersey. It belongs to the *Notommata contorta-silpha-tithasa* group of species which are characterized by the aberrant structure of the corona; the auricles are replaced by non-evertile tufts of locomotor cilia, and the circumoral portion of the buccal plate is elevated, giving the lateral view a triangular appearance. In the main it differs from any of the above species in the absence of an eyespot—very unusual in the genus *Notommata*—and in the structure of the alimentary tract.

Notommata avena, new species

Figure 3

The body is cylindric and rather slender; its greatest width is somewhat less than one-fifth of the total length. This rotifer is very transparent, and the outline varies considerably with the state of contraction.

The skin folds limiting the neck are well marked. The trunk increases gradually in depth for about two-thirds of its length, whence it tapers rapidly to the tail which has one round lobe. The foot has two joints of about equal length. The toes are long, slender, and almost straight.

The dorsal antenna is a small setigerous papilla. The lateral antennae are prominent tubules, from the tips of which emerge long sensory seta.

The corona is of the normal *Notommata* type. The auricles are relatively small and carry moderately long cilia which are not continuous with the circumapical band.

The mastax is aberrant. All the elements are delicate and slender, the pumping action being correspondingly weak. The fulcrum is short and straight, having no enlargement of the posterior end. The rami are lyrate from the ventral view, and the dorsal portion is produced as an arc of a circle. Each uncus has one clubbed tooth. Each manubrium is reduced to a curved, rodlike cell, the base of which is

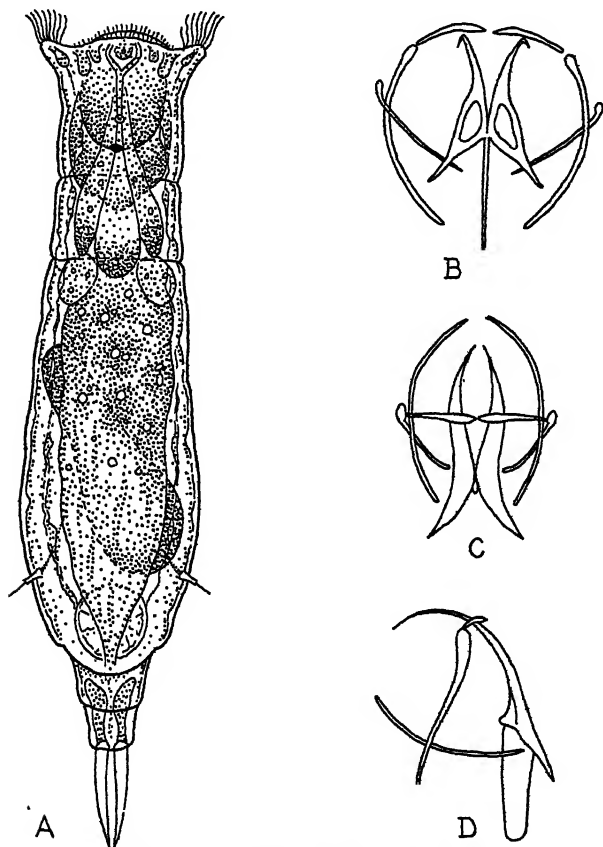


Fig. 3. *Notommata asena*, new species.

A, dorsal view; B, trophi, ventral view; C, trophi, frontal view; D, trophi, lateral view

slightly swollen. A pair of slender supporting rods passes under the manubria and terminates beneath the dorsal tips of the rami.

The stomach and intestine are not distinctly separated from each other. The gastric glands are small and oval. The ovary and bladder are normal. The foot glands are small.

The retrocerebral sac and subcerebral glands are long and pyriform; their distal ends are crowded with bacteroids, and the duct can be traced to the openings on the corona. The small eyespot is situated at the posterior end of the ganglion.

Total length, 340-365 μ ; toes, 40-45 μ .

HABITAT.—Submerged sphagnum in acid-water associations.

Notommata avena was collected in small numbers on Mount Desert Island. It has also been found on rare occasions in Atlantic County, New Jersey. The highly modified mastax bears a strong resemblance to certain species of the genus *Monommata*—especially *Monommata enedra* Myers—thus indicating their common ancestry.

In describing a new species, a group should not be split up into so many genera as to make each one absolutely homogenous. A monotypic genus should not be proposed unless a certain departure is very striking. If, however, the same modification occurs in several species, which in other respects are closely related, a new generic name should be introduced.

While the mastax of *Notommata avena* is aberrant, the animal agrees so well with the normal in other respects that it does not seem advisable to propose a new genus until more is known regarding its affinities.

Notommata apochaeta, new species

Figure 4

The body is cylindric and rather stout; its greatest depth is about one-fifth of the total length. The integument is flexible, but the outline remains constant, and the general shape is well retained at all times.

The head is long and the transverse fold, separating it from the abdomen, is well marked. The trunk is nearly parallel-sided. The tail is small and round. The foot is short and obscurely two-jointed. The toes are very small and conical.

The buccal plate extends down the ventral side for about one-third the total length of the animal. The auricles are small, and the marginal ciliation of the corona is continuous.

The dorsal and lateral antennae are minute setigerous papillae in the normal positions.

The mastax is of the virgate type. The fulcrum is long and slender; it expands gradually toward the posterior end which is serrate. The rami are without inner marginal teeth, and the dorsal portion is bent nearly at a right angle to the fulcrum. The right uncus has a very stout ventral tooth, clubbed near the tip; a rudimentary tooth is attached to its ventral side midway between the base and the tip. Following this are three slender accessories, decreasing in length and attached to a subsquare basal plate. The left uncus has a stout, slightly curved, opposing tooth, clubbed near the tip; this is followed by three accessories, also attached to a subsquare basal plate. The median branch of each manubrium is stout and curved dorsally near the tip; the basal plate is large and irregularly triangular in shape.

The gastric glands are small and subcircular. There is no constriction between the stomach and the intestine. The ovary is small and the bladder normal in size. The foot glands are nearly equal to the foot in length.

The ductless retrocerebral sac is round and clear. There are no subcerebral glands. The ganglion is large, and a round eyespot is attached to its posterior end.

Total length, 200-212 μ ; toes, 10-12 μ ; trophi, 34 μ .

HABITAT.—Submerged sphagnum in permanent bodies of acid water.

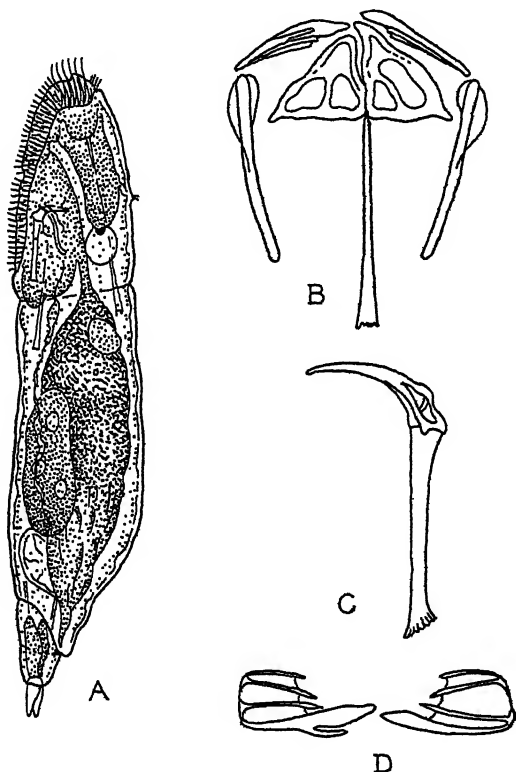


Fig. 4. *Notommata apochaeta*, new species.

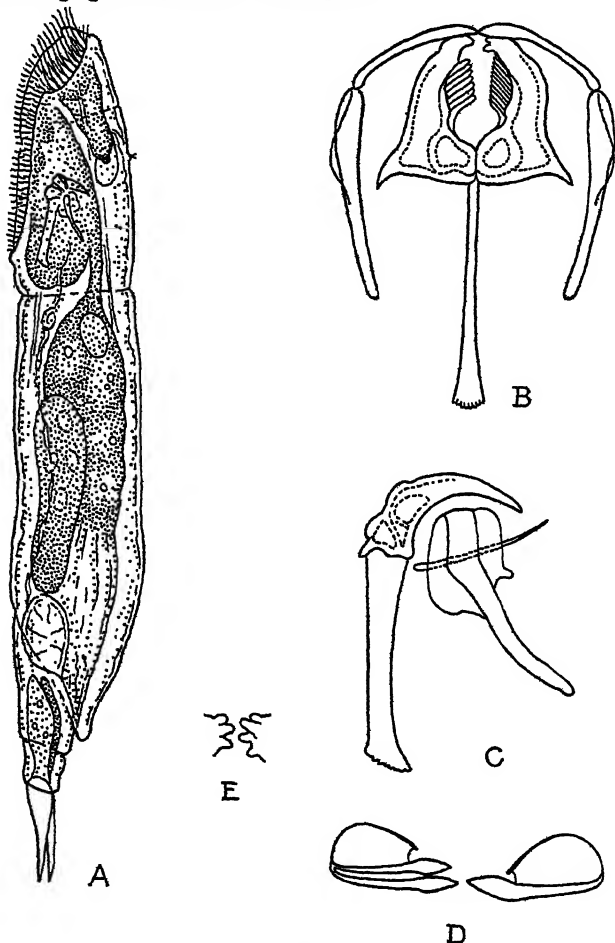
A, lateral view; B, trophi, ventral view; C, incus, lateral view; D, unci, frontal view.

Notommata apochaeta is fairly common in the littoral region of lakes and ponds on Mount Desert Island. It has also been found in Atlantic County, New Jersey and Vilas County, Wisconsin. It is related to *Notommata aurita* (Müller), but differs from that species in that it is much smaller, lacks the subcerebral glands, and has very different trophi.

***Notommata prodota*, new species**

Figure 5

The body is very slender and elongate; its greatest depth is somewhat more than one-sixth of the total length. The integument is very flexible, and the outline is constantly changing with the state of contraction.

Fig. 5. *Notommata prodota*, new species.

A, lateral view; B, trophi, ventral view; C, trophi, lateral view; D, unci, frontal view; E, apical teeth.

The head is relatively small, and there is a slight skin fold just in front of the dorsal antenna; a second, deeper fold divides the head from the abdomen. The trunk is cylindrical for nearly its entire length. The tail is small and has one round

lobe. The foot has two short joints. The toes are conical, ending in prolonged tips; the dorsal edges are straight and the ventral edges concave.

The dorsal and lateral antennae are minute setigerous papillae in the normal positions.

The corona is normal and extends down the ventral side about one-third the length of the body.

The mastax is of the virgate type. The fulcrum is long and gradually expands toward the posterior end which is wide and serrate. The rami are triangular from the ventral view, and the dorsal portion is bent abruptly at a right angle. At the apex of the right ramus there are three blunt teeth; the apex of the left bears four. Above the oral opening, on the ventral side, the right ramus carries a denticulate comb of seven or eight blunt teeth. The left ramus carries an opposing comb of numerous smaller teeth. The right uncus has two large subequal teeth, clubbed near the tips; the left uncus has one large tooth, also clubbed near the tip. Each manubrium is stout, and the median branch has a sharp change of direction at a point one-fourth of the distance from the base; from that point it curves slightly dorsad. The basal plate is subsquare and carries a blunt, toothlike process on the dorsal side. A thin pair of supporting rods passes under the manubria and terminates below the tips of the rami.

The esophagus is long and slender. The gastric glands are very small and oval. There is only a slight constriction between the stomach and the intestine. The bladder and ovary are normal. The foot glands are long, stout, and club-shaped.

The retrocerebral sac is small and clear; there are no subcerebral glands. The ganglion is relatively small, and the eyespot is situated at its posterior end.

Total length, 355 μ ; toes, 35 μ .

HABITAT.—Submerged aquatic vegetation in acid-water associations.

Notommata prodota is evidently rare. A few specimens were collected in Round Pond during the summer of 1924. The trophi, together with the unusual toes, readily suffice to separate this species from any other in the genus.

Notommata fasciola, new species

Figure 6

The body is cylindric and very slender; its greatest depth is about one-seventh of the total length. The integument is flexible, but the outline remains quite constant.

The head is large and separated from the abdomen by a well-marked constriction. The trunk decreases gradually in depth from just back of the neck fold to the base of the foot. The tail is quite small and is composed of a single round lobe. The basal joint of the foot is short and stout; the terminal joint, very long and transversely wrinkled. The toes are compressed and parallel-sided from the dorsal view; they are stout and lanceolate from the lateral view.

The dorsal and lateral antennae are minute setigerous papillae in the normal positions.

The corona is prone and has two lateral ciliated areas corresponding to auricles, but not evertile. The buccal field is large, evenly ciliated, and projects strongly in the region around the mouth, giving the lateral view of the corona an angular appearance.

The mastax is of the virgate type. The fulcrum is a long slender plate with no posterior enlargement. The rami are triangular from the ventral view. About midway of their length they are bent at right angles to the fulcrum and are without inner marginal teeth or other irregularities. The right uncus has three, and the left uncus four teeth, clubbed near their tips. The manubria are nearly straight and equally developed. The anterior lamellar portion is expanded and subsquare; the median branch is stout and slightly recurved near the posterior end.

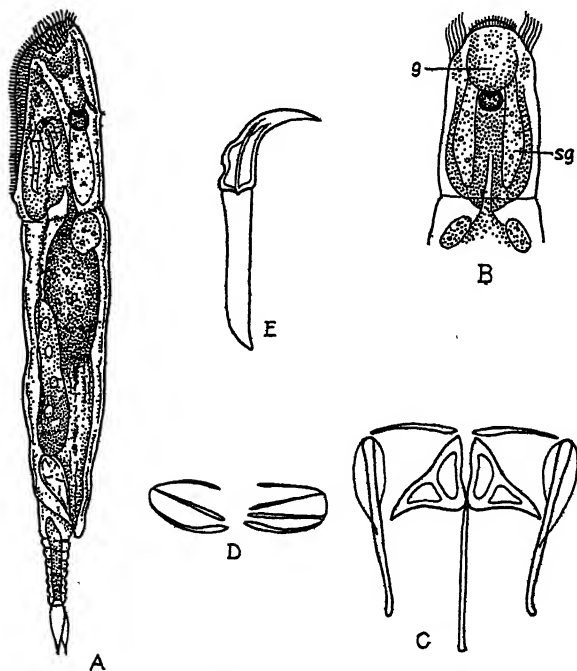


Fig. 6. *Notommata fasciola*, new species.

A, lateral view. B, head, dorsal view: g, ganglion; sg, subcerebral glands. C, trophi, ventral view; D, unci, frontal view; E, incus, lateral view.

The gastric glands are small and oval. The stomach is separated from the clear intestine by a shallow constriction. The ovary and bladder are normal. The foot glands are long and slender, extending almost to the base of the foot.

The retrocerebral sac is small, round, and ductless; it is frequently crowded with bacteroids. The subcerebral glands are very long and arise from the posterior end of the ganglion, one on each side of the retrocerebral sac. The ganglion is small and carries the eyespot at its posterior end.

Total length, 163–175 μ ; toes, 13–16 μ .

HABITAT.—Submerged sphagnum in acid-water associations.

Notommata fasciola is not uncommon on Mount Desert Island; Atlantic County, New Jersey; and Vilas County, Wisconsin. The trophi resemble those of *Notommata pseudocerebrus* De Beauchamp. The rotifer belongs, however, to that group, within the genus *Notommata*, that has a diglenoid type of trophi. This character, the pendant subcerebral glands, the wrinkled foot, and the elements of the trophi, are sufficient to separate this species from any other member of the genus.

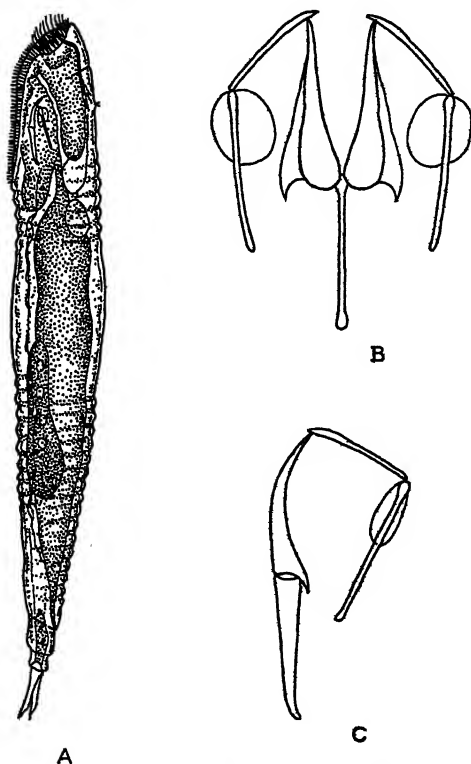


Fig. 7. *Notommata rugosa*, new species.
A, lateral view; B, trophi, ventral view; C, trophi, lateral view.

Notommata rugosa, new species

Figure 7

The body is elongate, tapering, and very slender; its greatest depth is only about one-seventh of the total length. The integument is very flexible, and the outline is constantly changing with the contortions of the individual.

The head is short and narrow, and there is a skin fold just in front of the dorsal antenna. Instead of the usual constriction there is a series of elevations and depressions limiting the head posteriorly. The abdomen is nearly cylindrical and is also limited by a series of elevations and depressions, extending from the level of the ovary to the base of the minute tail. The foot is short and has two joints, the ultimate being much shorter than the basal. The toes are very slender; the bases are somewhat enlarged and then taper gradually to minute papillose tips.

The dorsal antenna is a small setigerous papilla; the lateral antennae were not observed.

The corona is nearly ventral and consists of a simple evenly ciliated area with non-evertile lateral tufts of strong cilia adapted for propulsion.

The mastax is a modification of the virgate type, prehension being the primary function and suction secondary. The fulcrum is long, slender, and tapering. The rami are roughly triangular from the ventral view and have large symmetrical alulae. Each uncus has one long slender tooth, slightly clubbed near the tip. The basal plate of each manubrium is rather large and round; the central branch is a long straight rod. The salivary glands are very large and uniform in size.

The gastric glands are small and oval. There is no distinct separation between the stomach and the intestine. The foot glands are small and slender.

The rectocerebral sac is clear and nearly spherical, its duct being traceable to the outlets on the corona. There is a minute eyespot situated at the posterior end of the long ganglion.

Total length, 180 μ ; toes, 15 μ .

HABITAT.—Submerged sphagnum in lofty acid-water associations.

Notommata rugosa is evidently rare. A few specimens were collected during the summer of 1927 in Jordan Mountain Pond, a small body of permanent water (elevation about eleven hundred feet), situated in a rocky declivity between the summits of Jordan and Sargent mountains. The species is intermediate between the genera *Notommata* and *Pleurotrocha*, partaking of the characters of both. It is placed in the genus *Notommata* provisionally, on account of the prone corona, the position of the mouth opening, and the presence of a retrocerebral sac. The salivary glands, the trophi, and the presence of only one tooth in each uncus, together with the nearly straight incus, are evidences of its affinities with *Pleurotrocha*.

***Proales phaeopsis*, new species**

Figure 8

The body is elongate, fusiform, and slender; its greatest width is about one-fifth of the total length. The integument is soft and flexible, and the rotifer is very transparent.

The head is marked off from the trunk by a well-defined neck constriction. The abdomen is widest just behind the neck, whence it gradually tapers to the toes. There are several obscure skin folds on the posterior portion of the abdomen. The foot is

short and has only one joint. The toes are conical and stout; they diminish suddenly to rather blunt, outcurved tips.

The dorsal antenna is a minute setigerous papilla; the lateral antennae were not observed.

The corona is nearly frontal. The ciliation of the buccal field is short and dense; it does not extend ventrally beyond the mouth.

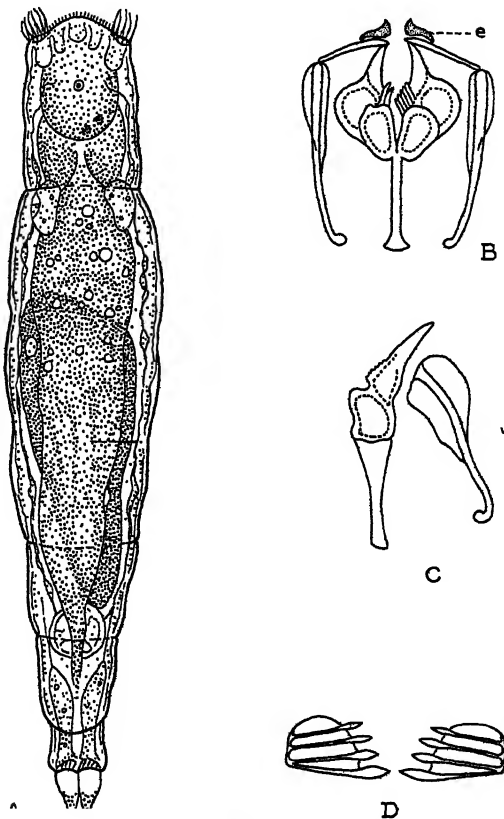


Fig. 8. *Proales phaeopsis*, new species.

A, dorsal view. B, trophi, ventral oblique view: e, epipharynx. C, incus and manubrium, lateral view; D, undel, frontal view.

The mastax is a modification of the malleate type; it has a pair of large, confluent salivary glands arising from the posterior portion of the lateral lobes. The incus is nearly straight; the fulcrum is stout and terminates in a fanlike enlargement. The rami have prominent basal apophyses. Near midlength, the right ramus has two stout teeth, and the left ramus has a comblike plate of five slender, appressed teeth. Each uncus has five long teeth, clubbed near their tips; they gradually decrease in

length and size dorsally and are attached to a subcircular basal plate. The anterior portions of the manubria are broadly expanded, the lateral branches being one-half the length of the median branch, the posterior tip of which suddenly curves toward the ventral side and ends in a knoblike expansion. In front of the rami are two epipharyngeal rods of irregular shape.

The gastric glands are very small and reniform. The stomach is not sharply marked off from the clear intestine. The ovary is very large and pyriform. The foot glands are long and stout.

There is no trace of a rectocerebral sac. The eyespot is situated on the ganglion, somewhat forward and to the right of the median line. Just below the main eyespot and somewhat nearer the median line is a smaller, secondary eyespot.

Total length, 340 μ ; toes, 20 μ .

HABITAT.—Submerged aquatic vegetation in small bodies of permanent acid water.

Proales phaeopis is evidently rare. A few specimens were found in several locations during the summer of 1926. It somewhat resembles *Proales sordida* Gosse. The presence of a secondary eyespot, the differences in the trophi, and the absence of a dorsal spur at the base of the toes clearly distinguish it from that species.

Proales adenodis, new species

Figure 9

The body is elongate, fusiform, and slender; its greatest width is just behind the neck constriction, a condition produced by the very large gastric glands. The entire body is very hyaline and flexible, varying greatly in shape with the contortions of the individual.

The head is relatively small and has a characteristic swelling of the dorsal portion over the ganglion. The neck is sharply marked off by a deep constriction. The abdomen tapers gradually to the base of the toes. The foot is very long and continuous with the general outline of the body; it is composed of two joints. The toes are short and acute; they have bulbous bases, and there is a septum dividing the abruptly reduced tips from the basal portion.

The dorsal antenna is situated at the apex of the characteristic swelling of the head; the lateral antennae were not observed.

The corona is normal; it does not extend ventrally beyond the mouth.

The mastax is a modification of the malleate type and is relatively very small. The incus is nearly straight, indicating a weak pumping action. The fulcrum is robust and terminates in a fanlike enlargement. The rami have large basal apophyses; near midlength the right ramus has two blunt teeth and the left, one. The dorsal ends of the rami are pointed and also act as teeth. There are five well-developed, gradually diminishing teeth in each uncus, all united by a weblike plate. The manubria are long and stout. In front of the rami are two epipharyngeal pieces of irregular shape.

The gastric glands are very large and prominent, giving the portion of the trunk opposite them a swollen appearance. The stomach is not sharply separated from the intestine. The ovary is relatively small and the bladder is normal. The foot glands

are very long, extending forward a little beyond the anal skin fold; to the base of each is attached a small pair of rudimentary glands.

The ganglion is long and saccate. There are indications of a reduced retrocerebral sac, and portions of the duct can be traced forward for some distance. The eyespot is situated on the ganglion and is placed to the right of the median line. There are traces of an accessory eyespot slightly to the left and below the main eyespot.

Total length, 290 μ ; toes, 15 μ .

HABITAT.—Among aquatic vegetation in acid-water associations.

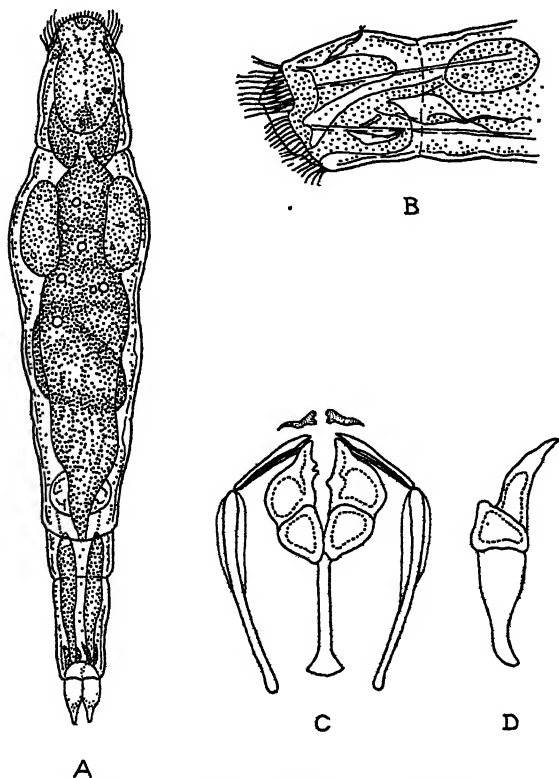


Fig. 9. *Proales adenodis*, new species.

A, dorsal view; B, head, lateral view; C, trophi, ventral view; D, incus, lateral view.

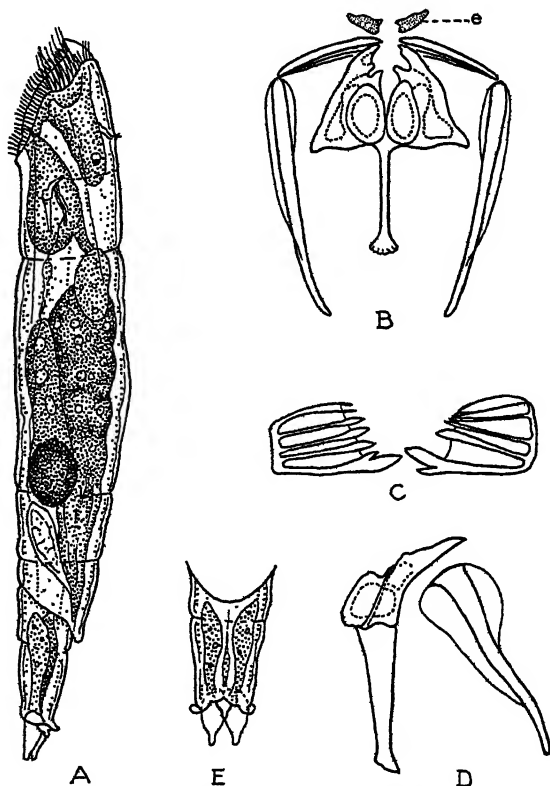
Proales adenodis was collected in small numbers in the Witch Hole and Long Lake. It bears a certain resemblance to *Proales phaeopis* Myers, being almost as large. It differs, however, in having much larger gastric glands, a much longer foot and glands, in the presence of a rudimentary retrocerebral sac, and in the different trophi.

***Proales ornata*, new species**

Figure 10

The body is elongate, slender, and fusiform; its greatest depth is about one-sixth of the total length. While the integument is soft and flexible, the general outline is quite constant.

The head is relatively long and pointed; the apex is in the form of a bare cuticular area limited posteriorly by a skin fold. It resembles the rostral process of the forci-

Fig. 10. *Proales ornata*, new species.

A, lateral view. B, trophi, ventral view; e, epipharynx. C, unci, frontal view; D, incus and manubrium, lateral view; E, toes, dorsal view.

pate notommatis. The neck constriction is well marked. The trunk is cylindrical and tapers gradually to the foot. There are two abdominal skin folds: one opposite the level of the posterior portion of the ovary, the other just in front of the anal skin fold. The foot is very long, and the terminal joint is about twice the length of the basal. The toes are short and stout, expanded at the base, then diminishing suddenly

and ending in blunt tips. Between the toes, at their base, and situated on the dorsal side, is a prominent, bulbous process surmounted by a minute papilla. On each dorsolateral side of the foot at its posterior end is a spurlike, cuticular process which is very characteristic and not present in any other species of the genus.

The dorsal antenna is a minute setigerous papilla; the lateral antennae were not observed.

The corona is very oblique, and the ciliation of the buccal field extends only a short distance beyond the mouth.

The mastax is a modification of the malleate type. The incus is not so straight as in some of the other species of the genus, but is more inclined dorsally. The fulcrum is long and terminates in a fanlike enlargement. The rami have large basal apophyses and, near midlength on the inner side, each ramus bears a strong blunt tooth. The dorsal ends of the rami are pointed and also act as teeth. The right uncus has six teeth; the first, or ventral tooth, is stout, bifurcate and clubbed near the tip; it is followed by three lesser, and two excessively slender accessories, all united by a lamellar plate. The left uncus has a very stout, bifurcate, ventral tooth, clubbed near the tip, followed by five teeth that gradually diminish in size, the last two being rudimentary. The manubria are long and nearly straight; the ventral branch is about three-fourths the length of the median branch; the dorsal branch is much shorter. In front of the rami are two epipharyngeal plates of irregular shape.

The gastric glands, stomach, ovary, and intestine are normal.

The ganglion is long. The eyespot consists of a globule of high refractive index, to the posterior portion of which is attached a disc of red pigment; it is situated on the ganglion some distance forward and to the right of the median line. There are no indications of a retrocerebral sac.

Total length, 254–278 μ ; toes, 14–18 μ ; trophi, 35 μ .

HABITAT.—Submerged sphagnum in permanent bodies of acid water.

Proales ornata is not common. A few scattered individuals were found during the summers of 1924–1931, inclusive. While it bears a superficial resemblance to *Proales decipiens* (Ehrenberg), the foot and toes are so characteristic that it cannot be mistaken for any other species of the genus.

***Proales granulosa*, new species**

Figure 11

The body is elongate and tapering. The outline is quite constant and is characterized by the lateral swellings produced by the very large gastric glands.

The head is small and not limited by a neck fold of the cuticle. The trunk gradually diminishes in breadth from opposite the gastric glands to the toes. The stomach is separated from the clear intestine by a shallow constriction. The foot continues the general outline of the body and is composed of two joints. The posterior portion of the terminal joint is divided, giving the short toes an appearance of being twice as long as they actually are.

The dorsal antenna is minute; the lateral antennae were not observed.

The buccal field is covered with short, densely set cilia, and the mouth is near the ventral edge.

The mastax is a modification of the malleate type. The incus is nearly straight. The fulcrum is quite long and tapers from a broad base to a fanlike posterior enlargement. Therami are lyrate from the ventral view, and have prominent basal apophyses. The alulae are large, excessively thin, lunate plates. Each ramus has two similar teeth, clubbed near their tips, and united by a weblike basal plate. The manubria are long and strongly incurved. In front of the rami are two small epipharyngeal pieces of irregular shape.

The gastric glands are very large and granulose; they contain central clusters of clear vacuoles. The walls of the stomach of the adult female are crowded with minute

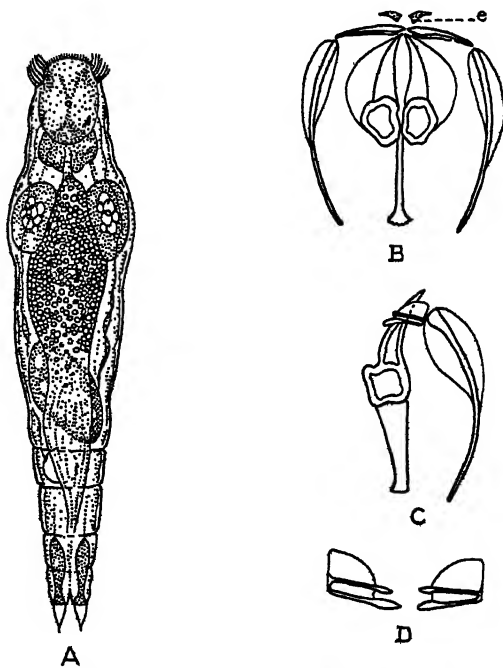


Fig. 11. *Proales granulosa*, new species.

A, dorsal view. B, trophi, ventral view: e, epipharynx. C, trophi, lateral view; D, uncus, frontal view.

algae, and there is a shallow constriction separating it from the intestine. The foot glands are equal to the foot in length.

The ganglion is large and saccate. There is a rudimentary retrocerebral sac composed of small granules and indications of a duct leading to the outlets on the corona. The eyespot is situated on the ganglion somewhat forward and to the right of the median line.

Total length, 140 μ ; toes, 6 μ .

HABITAT.—Submerged sphagnum in acid-water associations.

Proales granulosa is well distributed on Mount Desert Island and throughout Atlantic County, New Jersey. It belongs to a small assemblage of species somewhat resembling *Proales decipiens* (Ehrenberg), but differs from any of them in the shape of the toes, the rudimentary retrocerebral sac, the trophi, and the unusual gastric glands.

***Proales bemata*, new species**

Figure 12

The body is tapering and cylindrical; it is divided into three nearly equal parts: the head, trunk, and foot. The integument is very soft and flexible, and the general shape varies considerably with the state of contraction.

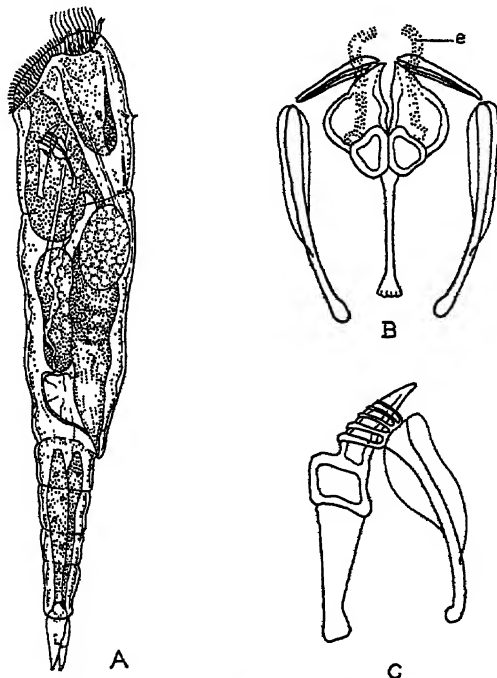


Fig. 12. *Proales bemata*, new species.

A, lateral view. B, trophi, ventral view: e, epipharynx. C, trophi, lateral view.

The head is large and separated from the abdomen by a well-marked neck constriction. The trunk tapers gradually to the foot, which is very long and four-jointed. The toes are short and acute; the anterior portions are slightly swollen, and a septum divides the tips from the basal portion.

The dorsal antenna is a minute setigerous papilla; the lateral antennae were not observed.

The corona is oblique. The ciliation does not extend ventrally beyond the mouth, which is situated at the lower edge of the buccal field.

The mastax is a modification of the malleate type. The incus is nearly straight. The fulcrum is long and is terminated by a fanlike enlargement. The rami have large basal apophyses, and there are no indications of internal denticulation beyond a slight swelling of the right ramus near midlength. Each uncus has five gradually diminishing teeth, clubbed near the tips. The median branch of each manubrium is prolonged posteriorly as a rather stout incurved rod, knobbed at the tip. In front of the rami are two elongate, irregular epipharyngeal rods.

The gastric glands are very large and vacuolated. The stomach, intestine, ovary, and bladder are all small. The foot glands are very stout and long, extending forward nearly as far as the anal skin fold.

There is a small, confluent retrocerebral sac crowded with bacteroids and attached to the dorsal side of the ganglion; the duct can be traced to the outlets on the corona. The eyespot is situated somewhat forward on the ganglion and to the right of the median line.

Total length, 132–145 μ ; toes, 12–15 μ ; trophi, 25 μ .

HABITAT.—Submerged aquatic vegetation in acid-water associations.

Proales bemata occurs in small numbers on Mount Desert Island and in Atlantic County, New Jersey. It does not bear much resemblance to any other species of the genus. The black retrocerebral sac should not be regarded as abnormal: all specimens of *Proales decipiens* Ehrenberg, from the Potomac River, had black, opaque sacs. The general shape, the large, vacuolated gastric glands, together with the differences in the trophi, readily separate this species from any other of the genus.

Proales gladia, new species

Figure 13

The body is elongate, vermiform, and nearly parallel-sided, diminishing very gradually to the base of the toes. There is no constriction separating the neck from the trunk.

The abdomen is nearly cylindrical. The foot is short and continuous with the body outline; it has only one joint. The toes are rather slender and undulate, ending in acute, slightly recurved tips.

The dorsal antenna is a minute setigerous papilla; no lateral antennae could be found.

The corona is prone. The dorsal arc of the circumapical band has entirely disappeared.

The mastax is a modification of the malleate type, and the trophi are somewhat asymmetric. The fulcrum is a short lamellar plate. The rami have prominent basal apophyses, and the alulae are very unequally developed: the right being short and blunt; the left, long, triangular, and acutely pointed. Near midlength, the right ramus carries a blunt tooth; the dorsal portion of the left ramus carries three short teeth. The right uncus has three strong teeth, clubbed near the tips; the left uncus has two. The manubria are unequally developed, the left being much longer than the right; the ends of both are sharply incurved and end in knoblike tips.

The esophagus is extremely short, being virtually confluent with the stomach, which, in turn, is separated from the intestine by a deep constriction. The gastric glands, bladder, and ovary are normal. The foot glands are long and pyriform, being equal to the foot in length.

There is a clear retrocerebral sac, the duct of which can be traced to the outlets on the corona. The ganglion is large, and a small, round eyespot is situated near the posterior end.

Total length, 150 μ ; toes, 15 μ ; trophi, 20 μ .

HABITAT.—Submerged sphagnum in lofty acid-water associations.

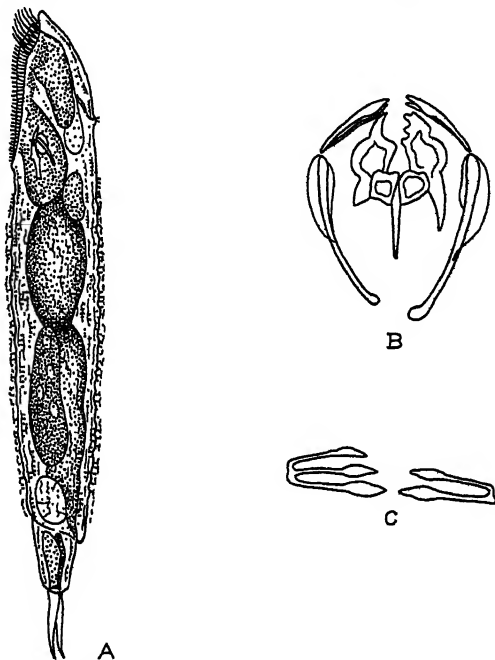


Fig 13. *Proales gladia*, new species.

A, lateral view; B, trophi, ventral view; C, unci, frontal view.

Proales gladia was found in small numbers in Jordan Mountain Pond, a small body of water (elevation about eleven hundred feet) situated directly above the ocean and lying between the summits of Sargent and Jordan mountains. The rotifer is sordid, its body being covered with fine particles of detritus adhering to a thin, mucilaginous investment. The prone corona, the characteristic alimentary tract, the sordid body, and the differences in the trophi separate this species readily enough from any other of the genus.

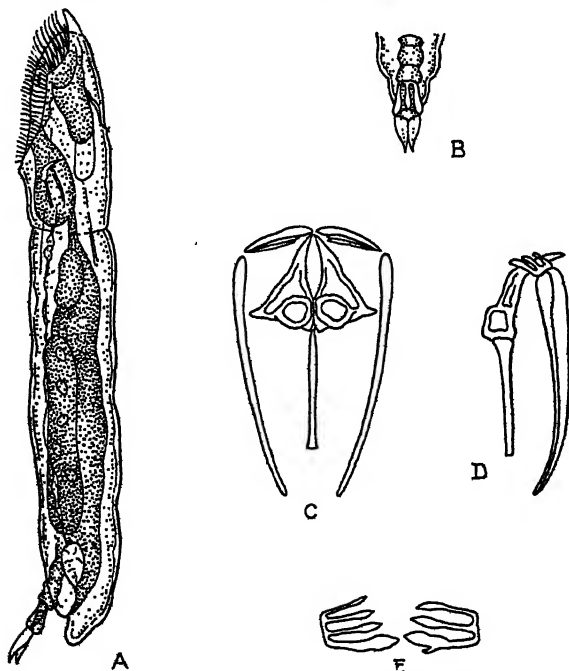
***Proales macrura*, new species**

Figure 14

The body is very long, parallel-sided, and cylindric. The integument is very flexible, and the outline is constantly changing with the contortions of the individual.

The head is long, being equal to about one-third of the total length of the animal. The abdomen is of the same depth throughout and ends in a prominent, overhanging tail.

The foot is ventrally placed; it is long, tubular, and has three well-marked joints. The toes are short and slightly undulate from the lateral view; from the ventral view they are swollen at the base, whence they diminish rapidly to fine recurved tips.

Fig. 14. *Proales macrura*, new species.

A, lateral view; B, foot and toes, ventral view; C, trophi, ventral view; D, trophi, lateral view, E, uncus, frontal view.

The corona is nearly prone and agrees with that of the forcipate notommatids. There are prominent lateral tufts of cilia, adapted for locomotion and resembling auricles, but they are not evertile. The buccal field is large and evenly ciliated. The dorsal arc of the circumapical band has entirely disappeared, and the apical area is modified as a prominent rostral process. The mouth is near the ventral edge of the corona.

The dorsal and lateral antennae are very minute setigerous papillae in the normal positions.

The mastax is a modification of the malleate type. The fulcrum is a long, straight rod. The rami are triangular from the ventral view and have rather prominent basal apophyses. The right uncus has four, and the left uncus three stout well-developed teeth. The manubrium is very long; the dorsal branch is narrow and equals the median branch in length. There is no ventral branch.

The gastric glands are somewhat ventrally placed, and are large and reniform. The stomach and the clear intestine are not separated by a constriction. The ovary is large and elongate. The bladder is small and situated just behind the base of the foot. The foot glands are unusually small, being confined to the terminal foot joint.

There is a clear, ductless retrocerebral sac attached to the posterior end of the ganglion which encloses the small eyespot.

Total length, 149 μ ; toes, 9 μ ; trophi, 20 μ .

HABITAT.—Marginal sphagnum in acid-water brooks.

Proales macrura was collected in Duck Brook, Mount Desert Island and Cordroy Creek, Atlantic County, New Jersey. It is provisionally placed in the genus *Proales* on account of its modified malleate mastax and the position of the mouth opening. The corona of *Proales decepiens* Ehrenberg, also resembles that of the forcipate notommatids. The apical area of that species is not enclosed by the circumapical band, and the corona is oblique: it also has a retrocerebral sac. The posterior portion of the body of *Proales macrura*, the tail, and the ventrally placed foot are unlike those of any other species of the genus and suffice to identify it at once.

New species of other genera of the Notommatidae will be described in Part III of the 'Distribution of Rotifera on Mount Desert Island,' and will appear in American Museum Novitates, No. 630.

BIBLIOGRAPHY

- BEAUCHAMP, P. DE. 1909. 'Recherches sur les Rotifères. Les formations tégumentaires et l'appareil digestif.' Arch. Zool. Expér., X, pp. 1-410, Pls. I-IX, text figs.
1932. 'Contribution à l'étude du genre *Ascomorpha* et des processus digestifs chez les Rotifères.' Bull. Soc. Zool. France, LVII, pp. 428-449, text figs.
- HARRING, H. K., AND MYERS, F. J. 1922. 'The rotifer fauna of Wisconsin.' Trans. Wis. Acad. Sci., XX, pp. 553-662, Pls. xli-lxi.
1924. 'The rotifer fauna of Wisconsin, II. A revision of the notommatid rotifers, exclusive of the Dicranophorinae.' Trans. Wis. Acad. Sci., XXI, pp. 415-594, Pls. xvi-xliii.
1926. 'The rotifer fauna of Wisconsin, III. A revision of the genera *Monostyla* and *Lecane*.' Trans. Wis. Acad. Sci., XXII, pp. 315-423, Pls. viii-lxvii.
1929. 'The rotifer fauna of Wisconsin, IV. The Dicranophorinae.' Trans. Wis. Acad. Sci., XXIII, pp. 667-808, Pls. xxii-xxix.
- MYERS, F. J. 1930. 'The rotifer fauna of Wisconsin, V. The genera *Euchlanis* and *Monommata*.' Trans. Wis. Acad. Sci., XXV, pp. 353-413, Pls. x-xxvi.
1931. 'The distribution of Rotifers on Mount Desert Island.' American Museum Novitates, No. 494, pp. 1-12.
- REMANE, A. 1929. 'Intrazelluläre Verdauung bei Rädertieren.' Zeits. wiss. Biol., Abt. C, II, pp. 146-154, text figs.
- 1929-1933. 'Rotatorien, Gastrotrichen und Kinorhynchen.' Bronn's 'Kl. und Ordn. des Tierr.', IV, Abt. II, 1, Lief. 1-3, pp. 1-448, Figs. 1-297.

AMERICAN MUSEUM NOVITATES

Number 660

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Sept. 15, 1933

59.51, 8 N (74.1)

THE DISTRIBUTION OF ROTIFERA ON MOUNT DESERT ISLAND. III¹

NEW NOTOMMATIDAE OF THE GENERA *PLEUROTROCHA*, *LINDIA*,
EOTHINA, *PROALINOPSIS*, AND *ENCENTRUM*

BY FRANK J. MYERS

In this paper the description of new species of Notommatidae collected at Mount Desert Island, Maine, and begun in Part II of this work is continued. As indicated in the title, ten new members of the genera are established, but since this paper is merely a continuation of Part II, the introductory matter there given is not repeated here.

New species (ten in number) described in this paper:

Pleurotrocha thura
Pleurotrocha chalicodis
Pleurotrocha channa
Lindia caerulea
Lindia eccla

Eothina poitera
Proalinopsis gracilis
Proalinopsis phacus
Proalinopsis selene
Encentrum caratum

ORDER PLOIMA

Family Notommatidae

Pleurotrocha thura, new species

Figure 1

The body is short, stout, and spindle-shaped; its greatest depth is little more than one-fourth of the total length. The integument is quite stiff, and the shape is very constant.

The head is small, and there is a well-marked neck constriction. The trunk gradually increases in depth for about one-half of its length, then tapers to the base of the foot, which is stout and has only one joint. The toes are very short, lanceolate, and acutely pointed.

The dorsal and lateral antennae are minute setigerous papillae in the normal positions.

The corona is oblique and consists of a marginal wreath of cilia with strong lateral tufts adapted for locomotion. The buccal field is evenly covered with short cilia, and the apical area is unciliated. The mouth is near the ventral margin of the corona.

¹Part I, comprising a faunal list of the rotifers of Mount Desert Island, Maine, appeared in 1931, American Museum Novitates, No. 494, pp. 1-12; Part II, describing new species of Notommatidae of the genera *Notommata* and *Proales*, was published in 1933, American Museum Novitates, No. 659, pp. 1 to 26, Figs. 1 to 14.

The mastax is of the virgate type, and the trophi are very simple. The fulcrum is a long, slender rod, continuing above the base of the rami for some distance and ending in an attenuate, bifid tip.

The rami are placed at right angles to the fulcrum; they are lyrate from the ventral view, and the tips are drawn out into slender points. The unci are two feeble, short, diverging rods. The manubria are undulate and without dorsal or ventral branches.

The gastric glands are small and oval. The stomach of the adult female is crowded with round unicellular algae. The intestine is clear. The ovary and bladder are normal. The foot glands are robust and extend slightly beyond the anal body segment.

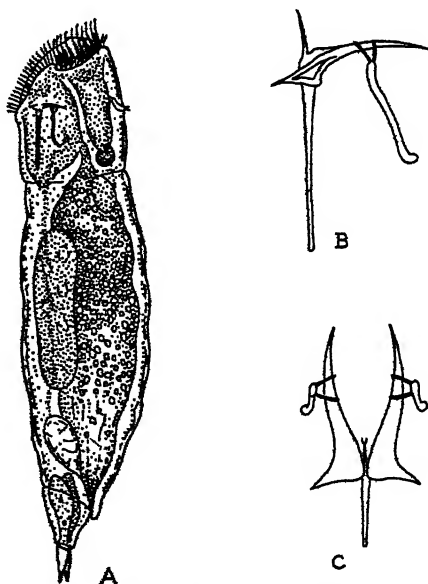


Fig. 1. *Pleurotrocha thura*, new species.

A, lateral view; B, trophi, lateral view; C, trophi, oblique dorsal view.

The retrocerebral sac is small, ductless, and globular; it is rendered opaque by the presence of densely crowded bacteroids. There are no subcerebral glands. The eyespot is situated on the dorsal side of the posterior portion of the ganglion.

Total length, 113–120 μ ; toes, 7–10 μ .

HABITAT.—Submerged aquatic vegetation in acid-water associations.

Pleurotrocha thura is common on Mount Desert Island; Vilas County, Wisconsin; and Atlantic County, New Jersey.

While Harring and Myers (1924, Trans. Wis. Acad. Sci., XXI, p. 458) state, in their definition of the genus *Pleurotrocha*, that there is

no trace of a retrocerebral sac, yet, due to the presence of other combined characters, this rotifer is placed in that genus. The retrocerebral sac and the cervical eyespot suggest its affinities with the genus *Notommata*, while this type of modified virgate mastax is common in the genus *Monommata*.

The swimming habit of *Pleurotrocha thura* is very characteristic. Locomotion is achieved by a series of short jumps followed by intervals of smooth gliding. *Pleurotrocha robusta* (Glasscott) has been observed to swim in the same manner.

De Beauchamp (1909) interpreted the presence of algae in the stomach walls of certain rotifers as a case of symbiosis. Remane (1929) has shown that in many instances, where the walls of the stomach are composed of syncytial cells, the presence of algae is due to intracellular digestion, as opposed to extracellular, the usual mode among rotifers. De Beauchamp (1932) has pointed out that algae can live for several days in the walls of the stomach before disintegrating. In the case of *Pleurotrocha thura*, intracellular digestion is rudimentary, as the rotifer has gastric glands. Rotifers, in which intracellular digestion is primary, have several large caeca forming part of the stomach, the gastric glands being absent.

***Pleurotrocha chalicodis*, new species**

Figure 2

The body is short and stout; its greatest depth is about one-fourth of the total length. The integument is soft and flexible, but the outline is quite constant.

The head is very large and long, being nearly one-third the total length of the animal. There is a marked diminution of the body depth starting at the neck fold, whence it tapers gradually to the very small tail. The foot is relatively stout and obscurely two-jointed. The toes are short; they are somewhat enlarged at the base, whence they diminish gradually, ending in papillose tips.

The corona is normal, and the buccal plate continues down the ventral side for some distance.

The dorsal antenna is a small setigerous papilla; the lateral antennae were not observed.

The mastax is a modification of the virgate type. The rami are slender and lyrate from the ventral view, and there is no denticulation on their inner margins. The fulcrum is a straight, slightly tapering lamellar plate, enlarged at the posterior end. The unci are extremely small rods, resting on the tips of the rami. The manubria are very slender and curved; near the posterior end there is an irregular enlargement with ventrally projecting lamella. The epipharynx consists of two large, very thin, oval plates, the points of which project slightly through the mouth opening.

The gastric glands are very large and reniform. The stomach and the clear intestine are separated by a shallow constriction. The ovary is quite large and there is no bladder, the cloaca functioning instead. The foot glands are slender and club-shaped.

The ganglion is ovate, and there is a clear, round, ductless retrocerebral sac attached to its posterior end; it encloses the lunate eyespot.

Total length, 130 μ ; toes, 10 μ .

HABITAT.—Marginal detritus in acid-water associations.

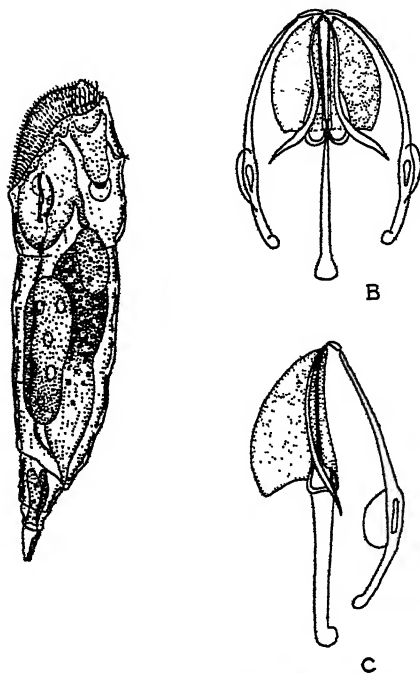


Fig. 2. *Pleurotrocha chalicodis*, new species.
A, lateral view; B, trophi, ventral view; C, trophi, lateral view.

Pleurotrocha chalicodis was found, during several summers, in the wide-spread connecting Long Lake and Somes Pond. It was also collected in a cranberry bog near Mays Landing, Atlantic County, New Jersey. Its nearest relative is probably *Pleurotrocha trypeta* (Harring and Myers). Although the trophi of these rotifers have a certain resemblance, the very large head, the presence of a retrocerebral sac, the large gastric glands, and the shape of the toes of *Pleurotrocha chalicodis*, readily separate it from the remaining species of the genus.

While *Pleurotrocha trypeta* is parasitic in *Gomphosphaera*, *Pleurotrocha chalicodis* is probably not parasitic. At least, all the specimens found were free and without indications of any host.

Pleurotrocha channa, new species

Figure 3

The body is very elongate, slender, and tapering; its greatest depth is about one-sixth of the total length. The integument is very thin and flexible, and the outline is constantly changing with the incessant contortions of the individual.

The head is relatively small and truncate anteriorly; it is separated from the trunk by a well-marked constriction. The greatest depth is just back of the neck fold, whence the abdomen gradually diminishes to the minute tail. The foot is fairly long, tubular, and obscurely two-jointed. The toes are short; their inner margins are straight and the outer edges swollen, whence they diminish abruptly to papillose tips.

The dorsal antenna is a small setigerous papilla; the lateral antennae were not observed.

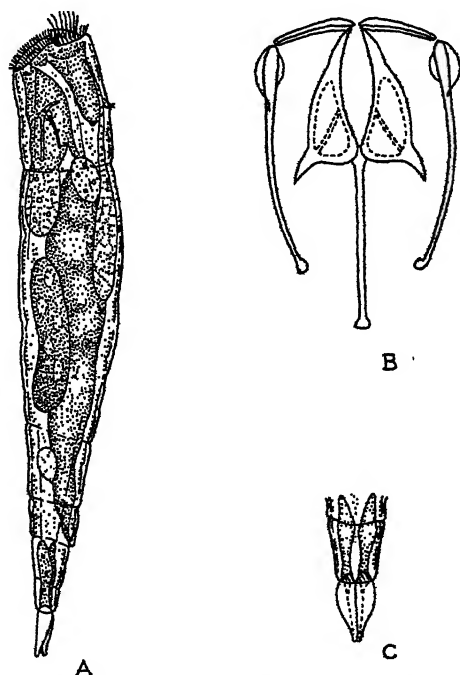


Fig. 3. *Pleurotrocha channa*, new species.

A, lateral view; B, trophi, ventral view; C, toes, dorsal view.

The corona is nearly frontal. The ciliation of the buccal field is short and dense; it does not extend ventrally beyond the mouth. The apical plate is unciliated and rather small.

The mastax is a modification of the virgate type. The fulcrum is long and slender, the posterior end being enlarged. The rami are triangular and without denticulation on the inner margins; the dorsal portion is inclined but not bent at a right angle, as

in the normal virgate type. Each uncus has two slender teeth, clubbed near the tips. The manubria are long, and the basal plate is very small and oval.

There is a pair of large salivary glands attached to the lobes of the mastax. No constriction separates the stomach from the intestine. The gastric glands are small and oval. The ovary is normal, and there is a very small bladder. The foot glands are club-shaped and nearly as long as the foot.

The ganglion is large and saccate with a small eyespot situated on its posterior edge. The retrocerebral sac is indistinctly vacuolated and exceptionally long, extending posteriorly for nearly one-half the length of the trunk.

Total length, 152-155 μ ; toes, 12-15 μ .

HABITAT.—Submerged sphagnum in acid-water associations.

Pleurotrocha channa is evidently rare. A few individuals were collected in Aunt Bettie Pond during the summer of 1924; it has not been found since. The pumping action of the mastax is reduced, as indicated by the long, slender tuerum, the nearly straight incus, and the small basal plates of the manubria. All of these are developed in the virgate type as supports for the walls during pumping action. However, in *Pleurotrocha channa* there are two long teeth in each incus, also a well-developed retrocerebral sac, both of which point toward the genus *Notommata*. Therefore, this species might well be considered as an intermediate type. The elongate, tapering body, the exceptionally long retrocerebral sac, and the shape of the toes are enough to identify it at once.

Lindia caerulea, new species

Figure 4

The body is very long, slender, and fusiform; its greatest width is slightly more than one-sixth of the total length. The integument is very flexible, and the outline varies greatly with the state of contraction.

The head segment is short, and the transverse neck fold is well marked. The abdomen is almost cylindric and tapers gradually from a point opposite the gastric glands to the base of the toes. There are three distinct transverse skin folds: one just to the rear of the gastric glands; one opposite the junction of the stomach with the intestine; and one in front of the bladder. The tail is small and has one round lobe. The foot is continuous with the body outline and is indistinctly two-jointed. The first joint is very long, and the terminal joint is very short. The toes are slender and out-curved from the dorsal view; from the lateral view, they are stout and parallel-sided, diminishing abruptly to blunt tips.

The dorsal antenna is a small setigerous papilla in the normal position; the lateral antennae were not observed.

The corona extends down the ventral side about one-third the length of the body, the postoral section being long and slender.

The mastax is of the cardate type. The rami are lyrate from the ventral view and have well-developed alinae. The fulcrum is a sub-square plate of the same length as the rami. Each uncus has one stout functional tooth, followed by a much smaller

accessory directly attached to the principal tooth by a short, curved prolongation. Each manubrium has a large, crescent-shaped anterior branch. The median branch is stout and slightly incurved; the dorsal branch is lamellar and curved outward. The epipharynx consists of two elongate plates, the posterior margins of which are bifid.

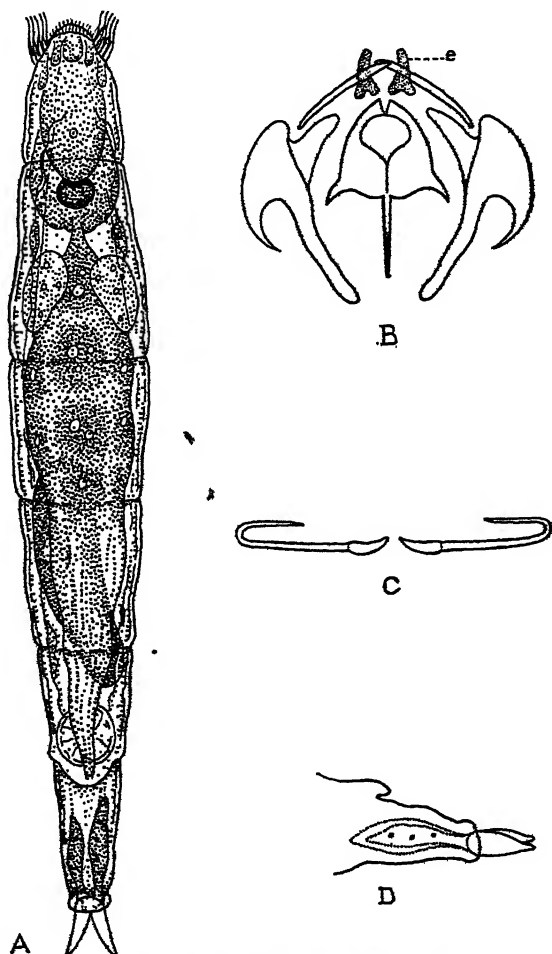


Fig. 4. *Lindia caerulea*, new species.

A, dorsal view. B, trophi, ventral view: e, epipharynx. C, unci, frontal view; D, toes, lateral view.

The gastric glands are large and pyriform. The stomach and intestine are indistinctly separated. The bladder is small, and the ovary is normal. The foot glands are robust, the right gland being larger than the left.

The retrocerebral organ is reduced to a small, ductless sac filled with red pigment granules and encloses the eyespot, which is situated at the posterior end of the ganglion.

Total length, 400 μ ; toes, 18 μ .

HABITAT.—Among *Nitella* and *Batrachospermum* in permanent bodies of acid water.

Lindia caerulea is evidently rare. It was first found associated with *Lindia ecela* Myers, in the Witch Hole. It was present for several summers wherever *Nitella* and *Batrachospermum* were to be found. It differs from *Lindia ecela* Myers and *Lindia producta* Harring and Myers, in its much smaller size, in the unequal foot glands, in the general shape of the body, and in the elements of the trophi and the different toes.

Lindia ecela, new species

Figure 5

The body is elongate, cylindric, and slender; its greatest width is about one-fifth of the total length. The integument is very flexible, and the outline varies greatly with the state of contraction.

The head is small and the neck fold obscurely marked. The abdomen is swollen posteriorly and tapers rather abruptly to the small, round tail. The foot is extremely short, being only as long as the toes, which are small and acute.

The dorsal and lateral antennae are minute setigerous papillae in the normal positions.

The corona extends down the ventral side nearly one-third the length of the body, the posterior portion being very long and slender.

The mastax is of the cardate type. The rami are lyrate, and their external edges are provided with a thin lunate extension. The fulcrum is a subsquare plate, being about as long as the rami. Each uncus has one long, slender ventral tooth and a smaller accessory, united by a weblike plate. Each manubrium has a large, crescent-shaped anterior branch. The dorsal branch is undulate and curves inward. The epipharynx is composed of two irregularly shaped plates, the inner edges of which are very finely denticulate.

The gastric glands are reniform and of moderate size. The stomach and intestine are indistinctly separated. The bladder is normal and the ovary large and elongate. The foot glands are relatively short and slender.

The retrocerebral sac is round and ductless; it is filled with red pigment granules and encloses the eyespot, which is situated at the posterior end of the ganglion.

Total length, 570 μ ; toes, 32 μ .

HABITAT.—Among *Nitella* and *Batrachospermum* in permanent bodies of acid water.

Lindia ecela was fairly common in small bodies of acid water, during the summer of 1927, in association with *Nitella* and *Batrachospermum*. It evidently feeds on blue-green algae, as the stomach is always colored a bright tint of blue. This species is closely related to

Lindia producta Harring and Myers, from which it differs in the shape of the toes, the presence of a well-developed epipharynx, and in the elements of the trophi.

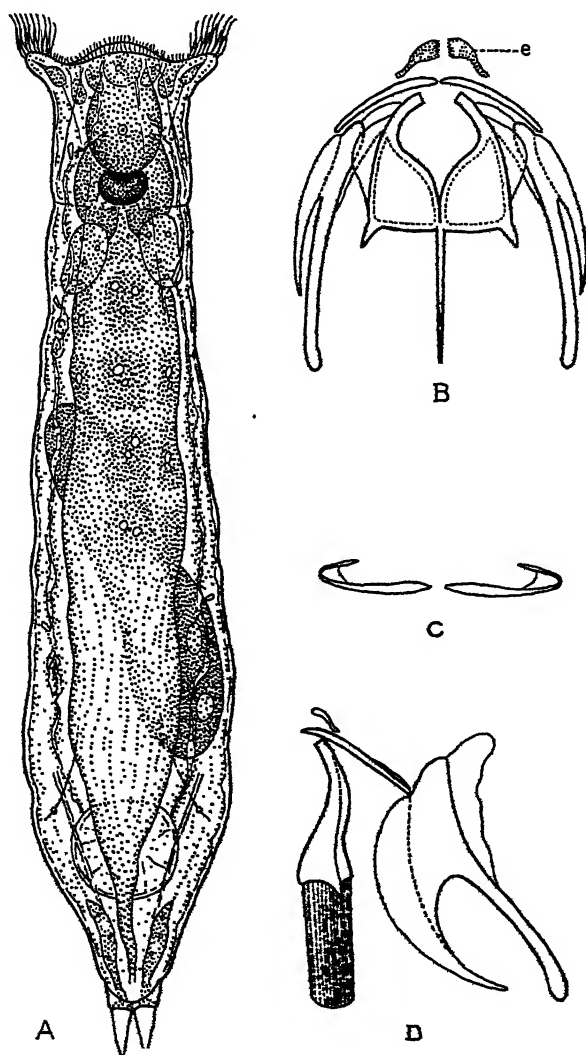


Fig. 5. *Lindia eccla*, new species.

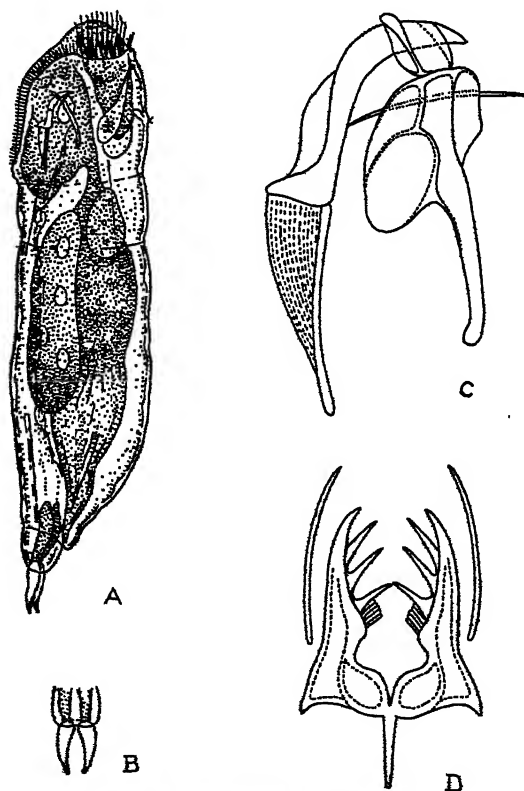
A, dorsal view. B, trophi, ventral view; e, epipharynx. C, unci, frontal view; D, trophi, lateral view.

***Eothina poitera*, new species**

Figure 6

The body is short, stout, and cylindric; its greatest width is slightly less than one-fifth of the total length. The animal is hyaline and the integument very flexible, the outline changing constantly with the contortions of the individual.

The head is short and stout; the transverse folds limiting the neck segment are well marked. The abdomen is nearly parallel-sided for about two-thirds of its length, then tapers abruptly to the base of the toes. The foot is very short and has

Fig. 6. *Eothina poitera*, new species.

A, lateral view; B, toes, dorsal view; C, trophi, lateral view; D, trophi, oblique frontal view.

only one joint. The toes are narrow and undulate from the lateral view; from the dorsal view, they have enlarged bases which diminish gradually to acute, incurved tips.

The dorsal and lateral antennae are minute setigerous papillae in the normal positions.

The corona extends down the ventral side about one-fourth the length of the body. The unciliated apical area is strongly convex; the buccal plate has a well-marked median depression in which the mouth is situated. The marginal ciliation is short, except on the two lateral arcs which have long cilia adapted for locomotion.

The mastax is of a specialized virgate type. The fulcrum is broad at the base and tapers gradually to a slender, rodlike posterior section. The rami are triangular and symmetrical; there is a heart-shaped opening just above the fulcrum; this is followed by four or five short, slender, and three very long, acute teeth, situated on the dorsal portion of each ramus. Each uncus has a single, strong tooth attached to a weblike plate. The anterior expanded portion of each manubrium is large and roughly oval; the median branch is nearly straight and has a slight terminal expansion. Two slender rods are imbedded in the walls of the mastax just below the posterior edges of the rami; they serve as supports during pumping action.

The stomach and intestine are separated by a slight constriction. The gastric glands are large and pyriform. The cloaca functions as a bladder. The foot glands are long and slender.

The retrocerebral sac is small, clear, and pyriform. The subcerebral glands are nearly as long as the sac and always contain a round cluster of bacteroids at the level of the eyespot. There are two accessory frontal eyespots on the apical area, in addition to the cervical eyespot at the posterior end of the ganglion.

Total length, 190–220 μ ; toes, 13–18 μ .

HABITAT.—Among decaying *Utricularia* on the surface of a small stream.

Eothina poitera is evidently rare. It was collected only in the Barcelona, a meandering, flood-plain stream, which drains a large marsh and empties into Frenchman's Bay.

The principal differences between the species of the genus *Eothina* are:

Eothina elongata (Ehrenberg).—Body elongate, slender; foot long, two-jointed; toes straight and stout; tips of rami with numerous close-set teeth; bladder present; total length, 350–400 μ .

Eothina tryphaea Harring and Myers.—Body moderately elongate; foot short and broad, two-jointed; toes slender, bulbous enlargement at bases; rami armed with numerous needle-like teeth extending from base to apex; bladder absent; total length 175–250 μ .

Eothina argus Harring and Myers.—Body moderately elongate; foot short and narrow, two-jointed; toes of medium length, slender and conical; rami with four or five stout teeth just below apex; bladder absent; total length, 250–300 μ .

Eothina poitera Myers.—Body short and stout; foot short, one joint; toes short and undulate from the lateral view; tips of rami with three prominent long teeth; bladder absent; total length 180–200 μ .

Procalinopsis gracilis, new species

Figure 7

The body is slender and tapering; its greatest depth is about one-seventh of the total length. The integument is flexible, but the general outline of the body is fairly constant.

The head and abdomen are separated by a well-marked constriction. The head segment is somewhat longer than wide and convex anteriorly. The abdomen is deepest near the middle, whence it tapers gradually to the tail, which is a small, knoblike papilla bearing a long, stiff spine. The foot is long and slender, the terminal joint being only one-fourth the length of the basal. The toes are of medium length and end in drawn out, acute tips.

The dorsal antenna is a small setigerous papilla; the lateral antennae were not observed.

The corona is an elongate oval area covering the oblique anterior surface of the head and terminating on the ventral side a short distance below the mouth. The marginal cilia are short, with the exception of the two lateral auricle-like arcs, which are provided with long cilia. The unciliated apical area is small, and the buccal plate is evenly ciliated.

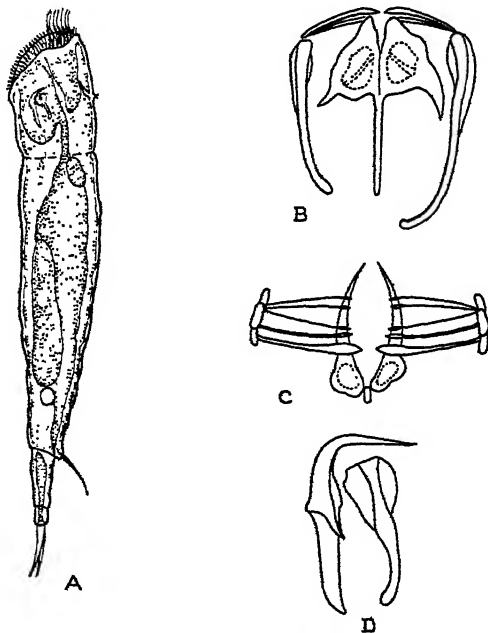


Fig. 7. *Proalinopsis gracilis*, new species.

A, lateral view; B, trophi, ventral view; C, trophi, frontal view; D, incus and manubrium, lateral view.

The mastax is of the virgate type, its primary function being evidently suction by pumping. The fulcrum is of moderate length and approximately parallel-sided. The rami are roughly triangular from the ventral view and without denticulation on the inner edges; the left alula is much longer than the right. Each uncus has one strongly developed ventral tooth, followed by four weaker accessories. The manubria are asymmetric, and the tips of the median branch are incurved.

The esophagus is long and slender. There is no constriction between the stomach and the intestine. The ovary is long, and the bladder is minute. The gastric glands are nearly as long as the foot.

The ganglion is normal and has a small, round eyespot, placed somewhat ventrally, attached to its posterior end.

Total length, 133–140 μ ; toes, 15–18 μ .

HABITAT.—Ponds among submerged aquatic vegetation.

Proales gracilis is quite common on Mount Desert Island; Atlantic County, New Jersey; Villas County, Wisconsin; and Montgomery County, Pennsylvania. Its nearest relative is *Proalinopsis phacus* Myers, from which it is readily distinguished by the normal dorsal antenna; the foot, the ultimate joint of which is very short and unwrinkled; and by the differences in the trophi.

Harring and Myers (1924, *op. cit.*, p. 440) in their description of *Proales staurus*, state that there is no eyespot present. Later research has shown that the species has an eyespot; sometimes it is very pale and hard to see, but always present. Therefore, so far as is known, all species of the genus have a cervical eyespot.

Proalinopsis phacus, new species

Figure 8

The body is extremely slender and tapering; its greatest depth is about one-seventh of the total length. The integument is very flexible, and the outline varies greatly with the contortions of the individual.

The head and abdomen are separated by a shallow constriction, whence the body tapers gradually to the tail, which is a prominent knoblike papilla bearing a very short curved spine. The foot is extremely long and slender; it is composed of two joints of equal length, the terminal one being transversely wrinkled. The toes are bulbous at the base, then diminish suddenly and end in very slender drawn-out tips.

The dorsal antenna is a large knoblike elevation in the normal position; the lateral antennae were not observed.

The corona is oblique and terminates just below the mouth. The ciliation is normal, and the two lateral arcs of locomotor cilia are exceptionally long.

The mastax is a modification of the virgate type. The rami are asymmetric and without teeth on the inner margins; the posterior portion is at a right angle to the fulcrum, suggesting that pumping is the primary function and that the grinding of food is secondary. The fulcrum is long and gradually tapers to the posterior tip. Each uncus has four long slender teeth, clubbed at the tips, and decreasing in size toward the posterior margin. The manubria are asymmetric. The left manubrium is very long and incurved near the tip; the right is short and nearly straight.

The esophagus is long and slender. There is a slight constriction between the stomach and the intestine. The ovary is normal and the bladder minute. The gastric glands are small and reniform. The foot glands are very long, extending almost to the level of the anal segment.

The ganglion is short and stout; there is a very small round eyespot attached to its posterior end.

Total length, 165-175 μ ; toes, 15 μ .

HABITAT.—Submerged sphagnum in acid-water associations

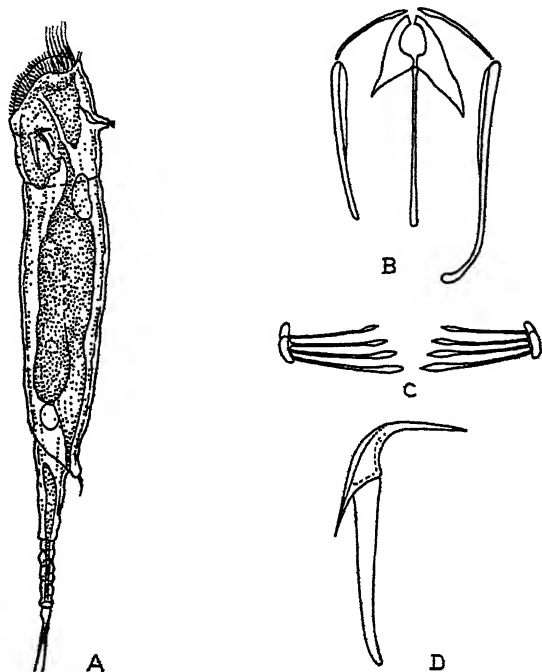


Fig. 8. *Proalinopsis phacus*, new species.

A, lateral view; B, trophi, ventral view; C, unci; D, incus, lateral view.

Proalinopsis phacus is evidently rare. A few specimens were collected in the Witch Hole, Mount Desert Island, and later, in Lenapi Lake, Atlantic County, New Jersey. The very long slender foot, the peculiar toes, bulbous at the base, the very short tail-spine, and the prominent dorsal antenna, separate this readily enough from the remaining species of the genus.

Proalinopsis selene, new species

Figure 9

The body is slender and fusiform; its greatest depth is somewhat over one-sixth of the total length. The integument is very flexible, and the outline constantly changes with the contractions of the animal. The entire body is very hyaline.

The head and abdomen are separated by a slight constriction. The head segment is somewhat longer than wide and subprone anteriorly. The abdomen is cylindric and parallel-sided; posteriorly it tapers gradually to the tail, which is a small knoblike papilla bearing a short, stiff, spindle-shaped spine. The foot is short and stout, appearing to have but one joint. The toes are slightly decurved, rather enlarged at the bases and tapering to slender acute tips.

The dorsal antenna is a small setigerous papilla; the lateral antennae were not observed.

The corona is nearly ventral and terminates a short distance below the mouth. The marginal cilia are short, with the exception of the usual lateral auricle-like arcs. There is a small unciliated apical area, and the buccal plate is evenly ciliated.

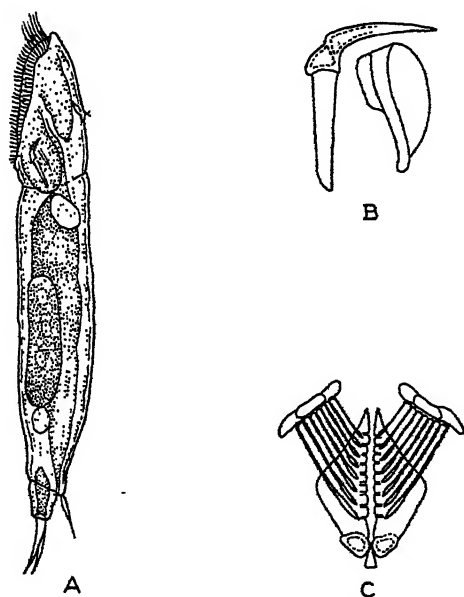


Fig. 9. *Proclinopsis selena*, new species.

A, lateral view; B, incus and manubrium, lateral view; C, trophi, frontal view.

The mastax is of a type intermediate between the malleate and the virgate, the primary function being equally divided between pumping and the crushing of food. The rami are symmetric and triangular; the posterior portion is bent at a right angle to the fulcrum, which is long and tapering, with no marked enlargement of the posterior end. Each incus has eight long slender teeth, clubbed near the tips; they decrease in size toward the posterior margin. The manubria are short and stout; the dorsal cell continues almost to the posterior end as a broadly curved plate.

The esophagus is evanescent. The ovary is normal and the bladder very small. The gastric glands are oval and of medium size. The foot glands are small and club-shaped.

The ganglion is long and carries a small eyespot attached to its posterior end.

Total length, 90 μ ; toes, 15 μ .

HABITAT.—Among algae in acid-water associations.

Proalinopsis selene seems to be rare, but this may be on account of its small size and secretive habits. A few specimens were collected in the Witch Hole and Lower Breakneck Pond. The small size, the prone corona, the lanceolate "tail-spine," and the short, single-jointed foot separate it readily enough from the remaining species of the genus.

***Encentrum caratum*, new species**

Figure 10

The body is elongate, very slender, and slightly gibbous dorsally; the venter is nearly straight. The integument is very flexible, but the outline, fairly constant.

The head is very long and marked by several dorsal skin folds; it is separated from the abdomen by a well-marked neck constriction.

The antennae are minute and in the normal positions.

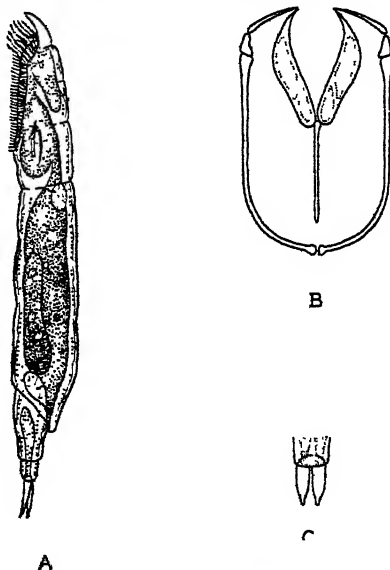


Fig. 10. *Encentrum caratum*, new species:
A, lateral view; B, trophi, ventral view; C, toes, dorsal view.

The corona is ventral, nearly as long as the head and has prominent lateral tufts of long cilia adapted for locomotion. The rostrum is very large, rounded anteriorly, and decurved.

The abdomen is cylindric and tapers rather abruptly, from over the lumbar region, to the minute tail. The integument is without longitudinal divisions, but the

oblique, circular skin fold, which usually limits the plates posteriorly, is well marked. The foot is composed of two joints, the terminal being only one-half the length of the basal. The toes are short, slender, and tapering; from the dorsal view, they appear stout and parallel-sided, diminishing abruptly to papillose tips.

The trophi are of the forcipate type. The rami are nearly parallel-sided and taper to acute, slightly incurved points. No alulae are present. The fulcrum is a long, slender plate. The unci are short, and a triangular intramalleus articulates with the long manubria, which nearly meet beneath the posterior tip of the fulcrum.

The gastric glands are very small and oval. The stomach and intestine are not distinctly separated. The ovary and bladder are normal. The foot glands are very long, slender, and slightly club-shaped.

The ganglion is saccate, and there is no retrocerebral sac nor are there any sub-cerebral glands. There are no indications of eyespots.

Total length, 145 μ ; toes, 12 μ .

HABITAT.—Marginal sphagnum in acid-water associations.

Encentrum caratum is fairly common on Mount Desert Island and in Atlantic County, New Jersey. It is related to *Encentrum elongatum* Harring and Myers, from which it differs mainly in the shape of the toes, the extremely large rostrum, the absence of a retrocerebral sac, and the variations in the trophi.

Judging from our present limited knowledge about rotifers, taxonomy and the study of geographical distribution is still of primary importance and will continue to be so until a much greater number of species, still unknown, are found and described. In fact, this is the foundation on which future studies must be based. Not until a great majority of the rotifers have their minutest variations classified and the details of their distribution tabulated will the idea that species are real and definite units, sharply marked off from other kinds of units, be established. There do exist some sharply circumscribed species, but other species intergrade with one another. There is no crucial test by which we can distinguish between a local race, a variety, and a species. There is often disagreement between systematists themselves as to whether a particular kind of rotifer shall be classified as a full species or a mere variety. There exist groups so variable that the extremes of variation would be regarded as different species did we not have a series of intermediates. It is only by intensive collecting and research that these variations are to be found and the affinities between certain groups brought to light.

New species of other genera of the Rotifera will be described in Part IV of the 'Distribution of Rotifera on Mt. Desert Island' and will appear in American Museum Novitates.

BIBLIOGRAPHY

- BEAUCHAMP, P. DE. 1909. 'Recherches sur les Rotifères. Les formations tégumentaires et l'appareil digestif.' Arch. Zool. Expériment., X, pp. 1-410, Pls. I-IX, text figs.
1932. 'Contribution à l'étude du genre *Ascomorpha* et des processus digestifs chez les Rotifères.' Bull. Soc. Zool. France, LVII, pp. 428-449, text figs.
- HARRING, H. K., AND MYERS, F. J. 1922. 'The rotifer fauna of Wisconsin.' Trans. Wis. Acad. Sci., XX, pp. 553-662, Pls. xli-lxi.
1924. 'The rotifer fauna of Wisconsin, II. A revision of the notommatid rotifers, exclusive of the Dicranophorinae.' Trans. Wis. Acad. Sci., XXI, pp. 415-594, Pls. xvi-xliii.
1926. 'The rotifer fauna of Wisconsin, III. A Revision of the genera *Monostyla* and *Lecane*.' Trans. Wis. Acad. Sci., XXII, pp. 315-423, Pls. viii-lxvii.
1929. 'The rotifer fauna of Wisconsin, IV. The Dicranophorinae.' Trans. Wis. Acad. Sci., XXIII, pp. 667-808, Pls. xxii-xxlix.
- MYERS, F. J. 1930. 'The rotifer fauna of Wisconsin, V. The genera *Euchlanis* and *Monommata*.' Trans. Wis. Acad. Sci., XXV, pp. 353-413, Pls. x-xxvi.
1931. 'The distribution of Rotifera on Mount Desert Island.' American Museum Novitates, No. 494, pp. 1-12.
1933. 'The distribution of Rotifera on Mount Desert Island, II.' American Museum Novitates, No. 659, pp. 1-26, Figs. 1-14.
- REMANE, A. 1929. 'Intrazelluläre Verdauung bei Rädertieren.' Zeits. wiss. Biol., Abt. C., II, pp. 146-154, text figs.
- 1929-1933. 'Rotatorien, Gastrotrichen und Kinorhynchen.' Bronn's 'Kl. und Ordn. des Tierr.', IV, Abt II, 1, Lief. 1-3, pp. 1-448, Figs. 1-297.

AMERICAN MUSEUM NOVITATES

Number 661

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Sept. 26, 1933

59.9, 32 S (801)

TAXONOMIC HISTORY OF THE NEOTROPICAL HARES OF THE GENUS *SYLVILAGUS*, SUBGENUS *TAPETI*

By G. H. H. TATE

The present paper is confined to a review of the taxonomic literature dealing with those species of *Sylvilagus* which inhabit South America, and those members of the "*Sylvilagus gabbi* group" of Nelson (1909) which occur in Central America. These latter are included because they represent the nearest allies geographically to the South American animals. Since the publication of Nelson's monograph 'The Rabbits of North America,' two races, *S. g. consobrinus* Anthony and *S. g. messorius* Goldman, have been added to the *gabbi* ranks.

TAXONOMIC HISTORY

1648. Marcgrave described (pp. 223-224) "*Tapeti brasiliensibus*, item est Cuniculi species, major quam Aperea, & dupla magnitudine gliris . . ." This animal Thomas (1901b) thought identifiable as the little hare of Rio de Janeiro (in 1913 named *tapetillus*) but subsequently (1911) correlated with the rather larger form found in the Pernambuco region.

The description furnished the basis of *Lepus brasiliensis* Linnaeus.

1693. Ray cited (pp. 205-206) Marcgrave's description.
1758. Linnaeus (I, p. 58) described *Lepus brasiliensis*, based upon his own 9th edition of 'Systema Naturae,' upon Marcgrave's *Tapeti* and upon Ray (who based his account upon Marcgrave's). See Thomas, 1901b, 1911, and 1913. [A great many compilers subsequently made reference to this species.]
1778. Pallas named (p. 30) Marcgrave's hare "*Lepus (tapeti)*." Thus a synonym of *brasiliensis*.
1782. Molina employed (p. 306) the term *Lepus minimus* for a cavy (probably of the genus *Galea*).
1801. Azara wrote (II, pp. 57-64) of the Tapiti (probably *paraguensis* Thomas).
1825. Wied discussed (pp. 450-452) "*Lepus brasiliensis*."

1830. Rengger gave (pp. 247-250) an account of "*Lepus brasiliensis*" (probably *paraguensis*).
1845. Tschudi stated (p. 198) that Poeppig found "*Lepus brasiliensis*" at Maynas on the Marañon (probably *de-filippi*).
1848. Waterhouse, reviewing the hares (pp. 1-146), dealt with *L. brasiliensis* (sic). His description was based partly upon a skin from Bolivia (probably *b. gibsoni* or *inca*), partly upon a skull from Pará (probably true *brasiliensis*) and fossil material from Lagoa Santa.
1850. Cornalia in Osculati described (p. 309) *Lepus de-filippi*, comparing it with *brasiliensis*.
1854. Burmeister reviewed (pp. 251-254) the data upon "*L. brasiliensis*," and contributed original observations.
1859. Baird distinguished (p. 575) as his section "D," the group of rabbits upon which Gray (1867) based *Sylvilagus*.
1860. Tomes recorded (p. 260) "*Lepus brasiliensis*," from Fraser's expedition to Ecuador. This may have been any one of a number of species of that country.
1867. Gray published (pp. 219-225) an important classification of the hares. He erected (p. 221) *Sylvilagus* and (p. 224) *Tapeti*. The former was founded upon section "D" of Baird (1859) and comprised the species *nanus*, *artemisias*, and *bachmanni*; the latter was proposed to contain *brasiliensis*.
1869. Frantzius recorded (pp. 247-325) "*Lepus brasiliensis*." This must have been a member of the *gabbi* group.
1872. Hensel discussed (p. 62) "*Lepus brasiliensis*" from Rio de Janeiro. He did not record it from Rio Grande do Sul. I suspect that Hensel's description referred to *tapetillus* Thomas.
1875. J. A. Allen, in his 'Synopsis of American Leporidae,' keyed out (p. 432) "*brasiliensis*" and gave for it (p. 435) a short synonymy. He failed to mention *de-filippi*.
1877. J. A. Allen described (pp. 348-350) "*Lepus brasiliensis* var. *gabbi*" and discussed "*L. brasiliensis*."
1880. Alston reviewed (pp. 175-181) the status of the Central American hares. He made *gabbi* Allen (1877) a full species.
1881. Trouessart followed (1880, p. 207) Gray's generic arrangement. He listed *gabbi* Allen and *defilippi* (sic) Cornalia as subspecies of "*brasiliensis*."

1882. Thomas recorded (p. 101) "*brasiliensis*" from Cutervo, Peru, 9000 feet. (Probably equal to his *capsalis*.)
1883. Pelzeln recorded (pp. 79-80) "*brasiliensis*" taken by Natterer from the Provinces São Paulo and Matto Grosso (*b. minensis* and *b. chapadae*?).
1888. Winge wrote (pp. 10-11, 110-114) of the Leporidae.
1890. J. A. Allen described (pp. 192-194) *Lepus truei*, comparing it with *palustris* and *aztecus*.
1891. J. A. Allen mentioned (p. 216) the almost total destruction of the "two types" of *gabbi* by museum pests.
1894. Hartert described (p. 40) *Lepus nigronuchalis*.
1894. Matschie recorded (p. 62) "*L. brasiliensis*" from near Tucuman and Jujuy (probably equal to *gibsoni*).
1896. Robinson recorded (p. 651) "*brasiliensis*" from Margarita (= *margaritae* Miller).
1897. Thomas described (pp. 551-552) *Lepus andinus*, comparing it with *sylvaticus*, and *Lepus cumanicus*. He suggested that *defilippi* was nearly allied to *brasiliensis*.
1898. Miller described (pp. 97-98) *Lepus margaritae*, related to *cumanicus*.
1898. Trouessart treated (pp. 658-663) *Sylvilagus* and *Tapeti* as subgenera of *Lepus*.
1899. J. A. Allen described (pp. 196-197) *Lepus (Sylvilagus) superciliaris*, compared with *cumanicus*. "Belongs to . . . the section represented by *L. insolitus* . . . no close relation to the subgenus *Tapeti*."
1899. Major discussed (pp. 433-520) the *Lagomorpha*.
1900. Thomas described (pp. 356-357) *Sylvilagus orinoci*.
1901. Bangs described (pp. 631-644) *Lepus (Tapeti) incitatus*, "an island form of *gabbi*."
- 1901a. Thomas described (pp. 543-545) *Sylvilagus surdaster*, which he compared with *gabbi*.
- 1901b. Thomas described (pp. 534-535) *Sylvilagus minensis*. He recognized three types of South Brazilian hares: the form from Paraguay, *minensis*, and true *brasiliensis*. He fixed the type locality of the last as Rio de Janeiro (but see Thomas, 1911 and 1913).
- 1901c. Thomas described (p. 539) *Sylvilagus paraguensis*, allied to *minensis*.
1903. Thomas described (pp. 241-242) *Sylvilagus minensis chapadae*.

1904. J. A. Allen published (p. 445) Smith's notes on *S. superciliaris*.
1904. Lyon published his 'Classification of the Hares and Their Allies.' In it *Tapeti* was merged (p. 334) with *Sylvilagus*.
1904. Nelson described (pp. 103-104) *Lepus (Sylvilagus) insonus*, allied to *gabbi*.
1904. Thomas described (p. 36) *Sylvilagus meridensis*, allied to *andinus*.
1905. Trouessart placed (pp. 536-539) the Central American rabbits of the *gabbi* group with *floridanus* in the subgenus *Sylvilagus* and all the South American ones in the subgenus *Tapeti*.
1908. J. A. Allen described (pp. 647-670) *Lepus gabbi tumacus*.
1909. Nelson published 'The Rabbits of North America.' In it (p. 257) *Tapeti* was shown as a subgenus of *Sylvilagus*. No species from south of Panama were discussed.
1910. Osgood described (pp. 29-30) *Sylvilagus arius*. He thought that many of the South American forms would eventually be reduced to subspecific rank.
1910. Trouessart described (pp. 25-27) *Sylvilagus (Tapeti) ecaudatus*.
1911. Thomas revised his views of 1901 and fixed (p. 146) the type locality of *brasiliensis* as Pernambuco (see also 1913).
1911. J. A. Allen recorded (p. 249) *S. cumanicus* Thomas from Tocuyo, fifty miles southwest of Barquisimeto, Venezuela.
1912. J. A. Allen described (p. 75) *Sylvilagus (Tapeti) fulvescens* which he compared with *surdaster* and *andinus*.
1912. Goldman described (pp. 1-18) *Sylvilagus gabbi messorius*.
1912. Osgood described (pp. 57-58) *Sylvilagus nigronuchalis continentis*.
1913. J. A. Allen described (pp. 476-477) *Sylvilagus (Tapeti) salentus*:
". . . belongs to the *Tapeti* section of the genus and is nearly related to *S. gabbi* . . ." It was compared with *surdaster*. He remarked also on *fulvescens*.
1913. Thomas referred a series from Lamarão, Bahia, to *brasiliensis* and gave the new name *tapetillus* to the very small species from Rio de Janeiro, which until 1911 had been called *brasiliensis*. He held that the Lamarão rabbits, *minensis*, *chapadensis*, and *paraguensis*, together with a new form, "*brasiliensis inca*," from eastern Peru (pp. 210-211), were all subspecies of a single wide-ranging species. He discussed also (p. 211) intergradation northward of "*brasiliensis*" with Colombian and Orinoco forms.

Next he reviewed (pp. 212-214) the *andinus* group,

- describing as new *Sylvilagus a. chimbanus*, *S. a. canarius*, and *S. capsalis*.
1913. Cabrera described (pp. 1-15) *Sylvilagus nivicola*. He made a key to the Andean forms and considered *ecaudatus* Trouessart a synonym of *a. andinus*. He afterwards discussed other South American hares.
1914. J. A. Allen described (pp. 199-200) *Sylvilagus daulensis*. He compared it with *surdaster*.
1914. Osgood commented (p. 171) upon *defilippi* and *inca*.
1914. Stone remarked (p. 15) upon *andinus*,—probably the subspecies *chimbanus*.
1914. Thomas described (pp. 410-414) *Sylvilagus valenciae*, which he compared with *cumanicus* and *orinoci*.
1916. J. A. Allen described (pp. 83-87) *Sylvilagus boylei*. He maintained that it "needed no comparison" with *continentis*, *cumanicus*, and *gabbi*.
1917. Anthony described (pp. 335-337) *Sylvilagus gabbi consobrinus*.
1918. Thomas described (pp. 186-193) *Sylvilagus brasiliensis gibsoni*, comparing it with *paraguensis*.
1920. Goldman commented (pp. 146-148) on the rabbits of Panama.
1920. Thomas described (pp. 31-33) *Sylvilagus apollinaris*, allied to *surdaster* and *meridensis*, and *S. purgatus*, which was compared to *margaritae*.
1921. Thomas described (pp. 442-443) *Sylvilagus nicefori*, "nearly allied to *S. apollinaris*."
1923. Anthony described (pp. 9-13) *Sylvilagus kelloggi* and *S. chillae*, comprising a "third group," set off from the *andinus* and *daulensis* groups.
1925. Pocock discussed (pp. 669-700) the external characters of the lagomorphs.
1927. Thomas admitted (p. 371) that the rabbits of the Moyobamba region of Peru might be *defilippi*.
1929. Dice discussed (pp. 340-344) the phylogeny of the Leporidae.
1929. Krieg commented (pp. 784-785) upon *S. paraguensis*.

Regarding the identity and type locality of *brasiliensis* some confusion has existed. *Brasiliensis* Linnaeus (1758) was based upon the Brazilian hare described by Maregrave. At first, Thomas (1901*b*) fixed *brasiliensis* upon the small rabbit of Rio de Janeiro, and this conclusion was accepted by Nelson in his monograph of the rabbits (1909). But in

1911 Thomas stated (without offering evidence to prove it) that Marcgrave,¹ on whose description *brasiliensis* was based, "stayed chiefly at 'Moritzstadt,' now Recife, most of his time, 1640-1644, while even his excursions were limited to the coast region between 5° 45' and 11° 11' S. . . ." In 1913, Thomas wrote of a series of rabbits from Lamarão, Bahia, which he included with true *brasiliensis* from a little farther north (Pernambuco).

As Thomas (1901b), has already remarked, Marcgrave described an extremely small hare. But any or all of the Brazilian species must have seemed small to him in comparison with those he knew in Europe. Moreover, his comparisons to show size "larger than a cavy, and double the size of a glire" are not particularly significant. Since the evidence points solely to the Pernambuco region as the scene of Marcgrave's activities and indicates (negatively) that he never reached Rio de Janeiro or farther south, we ought to conclude that Thomas's fixation of Rio de Janeiro as type locality for *brasiliensis* and his bestowal of that name on the tiny Rio hare (*tapetillus*) were both erroneous. In consequence, I feel that we must accept his designation of 1911: namely, that *brasiliensis* refers to the slightly larger animal of the Pernambuco region with Pernambuco itself fixed as its type locality.

A few words may be added regarding the orthography of Cornalia's hare. This author wrote *De-Filippi* (*sic*). In zoölogical writing we are at liberty to use small letters instead of capitals for patronymics, but, we are not permitted (Arts. 19, 20, 'International Rules of Nomenclature') to omit hyphens or diacritical marks. Accordingly the name must be written *de-filippi*.

LIST OF NAMED FORMS WITH TYPE LOCALITIES

South Amazonian Region

brasiliensis brasiliensis (Linnaeus)

Pernambuco, Brazil (Thomas, 1911),
Not Rio de Janeiro (Thomas, 1901)

Synonym: *tapeti* Pallas

brasiliensis paraguensis Thomas

Sapucay, Paraguay

brasiliensis minensis Thomas

Rio Jordão, S. W. Minas Geraes, Brazil
Santa Anna de Chapada, 30 miles north-
east of Cuyaba, Matto Grosso, Brazil,
800 m.

brasiliensis gibsoni Thomas

Manuel Elordi, Vermejo, Salta, Argen-
tina, 500 m.

brasiliensis inca Thomas

Cadena, Marcapata, Peru

¹For discussion of Marcgrave, see Gudger, 1912, Popular Science Monthly, LXXXI, p. 250, and 1914, Science, XL, p. 507.

tapetillus Thomas

Porto Real, near Rezende, Rio de Janeiro, Brazil

Orinoco and West Amazonian Region

de-filippi Cornalia

Woods of Quixos, eastern Ecuador

orinoci Thomas

Maipures, Upper Orinoco, Venezuela

valenciae Thomas

Near Lake Valencia, Carabobo, Venezuela

cumanicus Thomas

Cumana, Prov. Sucre, coast of Venezuela

margaritae Miller

Margarita Is., off Prov. of Sucre, Venezuela

Andean Region

capsalis Thomas

San Pablo, Cajamarca, Peru. 2000 m.

kelloggi Anthony

Guachanama, Prov. Loja, Ecuador, 9050 ft.

chillae Anthony

Salvias-Zaruma trail, Prov. Oro, Ecuador, 6600 ft.

andinus canarius Thomas

Cañar, Ecuador, 2600 meters

andinus chimbanus Thomas

Sinche, western slope of Mt. Chimborazo, Ecuador, 4000 m.

andinus andinus Thomas

Western slope of Mt. Cayambe, Ecuador, 4000 m.

Synonym?: *ecaudatus* Trouessart

Neighborhood of Quito, Ecuador

viricola Cabrera

Mt. Antisana, Ecuador, 4800 m.

salentus J. A. Allen

Salento, West Quindio Andes, Colombia, 7000 ft.

fulvescens J. A. Allen

Belen, western Andes, Colombia, 6000 ft.

apollinaris Thomas

Choachi, near Bogotá, Colombia

purgatus Thomas

Purificación, Magdalena Valley, S. W. of Bogotá, Colombia

nicefori Thomas

San Pedro, Medellín, Colombia

meridensis Thomas

Sierra de Merida, Venezuela

Panama, North Pacific and Caribbean coasts of South and Central America

daulensis J. A. Allen

Daule, Guayas, Ecuador

surdaster Thomas

Carondelet, R. Bogotá, Prov. Esmeraldas, Ecuador, 20 m.

superciliaris J. A. Allen

Bonda, Santa Marta Dist., Colombia

boylei J. A. Allen

La Playa, near Baranquilla, Colombia

nigronuchalis nigronuchalis Hartert

Aruba Island

nigronuchalis continentis Osgood

Maracaibo, Venezuela

avius Osgood

Testigo Grande, Testigos Islands, Venezuela

gabbi messorius Goldman

Cana, eastern Panama, 1800 ft.

gabbi consobrinus Anthony

Old Panama, Panama

gabbi incitatus Bangs

San Miguel Island, off Panama

gabbi gabbi J. A. Allen
gabbi tumacus J. A. Allen
gabbi truei J. A. Allen
gabbi insonus Nelson

Talamanca, Costa Rica
 Tuma, east of Matagalpa, Nicaragua
 Mirador, Mexico
 Omilteme, Guerrero, Mexico

LIST OF REFERENCES

- ALLEN, J. A. 1875. Proc. Bost. Soc. Nat. Hist., XVII, pp. 430-436.
 1877. 'Mongr. North Amer. Rodentia.' Hayden Survey Reports, XI, Leporidae, pp. 265-378.
 1890. Bull. Amer. Mus. Nat. Hist., III, pp. 175-194.
 1891. Bull. Amer. Mus. Nat. Hist., III, pp. 203-218.
 1899. Bull. Amer. Mus. Nat. Hist., XII, pp. 195-218.
 1904. Bull. Amer. Mus. Nat. Hist., XX, pp. 407-468.
 1908. Bull. Amer. Mus. Nat. Hist., XXIV, pp. 647-670.
 1911. Bull. Amer. Mus. Nat. Hist., XXX, pp. 239-273.
 1912. Bull. Amer. Mus. Nat. Hist., XXXI, pp. 71-95.
 1913. Bull. Amer. Mus. Nat. Hist., XXXII, pp. 469-484.
 1914. Bull. Amer. Mus. Nat. Hist., XXXIII, pp. 199-200.
 1916. Bull. Amer. Mus. Nat. Hist., XXXV, pp. 83-87.
- ALSTON, E. R. 1880. 'Biologia Centrali-Americana.' Mammalia.
- ANTHONY, H. E. 1917. Bull. Amer. Mus. Nat. Hist., XXXVII, pp. 335-337.
 1923. Amer. Mus. Novit., No. 55.
- AZARA, F. 1801. 'Essais Hist. Nat. Quadr. Paraguay,' II.
- BAIRD, S. F. 1859. 'Mammals of North America.'
- BANGS, O. 1901. Amer. Nat., XXXV, pp. 631-644.
- BURMEISTER, H. 1854. 'Syst. Übersicht Thiere Brasiliens.'
- CABRERA, A. 1913. Trab. Mus. Cien. Nat., Madrid, No. 9, pp. 1-15.
- CORNALIA, E., IN OSCULATI, C. 1850. 'Expl. . . . reg. . . . Amazoni,' Milan.
- DICE, L. R. 1929. Journ. Mamm., X, pp. 340-344.
- FRANTZIUS, A. VON. 1869. Arch. f. Nat., pp. 247-325.
- GOLDMAN, E. A. 1912. Smiths. Misc. Coll., LX, No. 2, pp. 1-18.
 1920. Smiths. Misc. Coll., LXIX, No. 5, pp. 1-309.

- GRAY, J. E. 1867. *Ann. Mag. Nat. Hist.*, (3) XX, pp. 219-225.
- HARTERT, E. 1894. *Novit. Zool.*, I, p. 40.
- HENSEL, R. 1872. *Abh. Ak. Wiss. Berl.*, pp. 1-130.
- KRIEG, H. 1929. *Z. Morph. Ökol. Tiere*, Berlin, XV, pp. 755-785.
- LINNAEUS, C. 1758. '*Syst. Nat.*,' 10th Ed., I, p. 58.
- LYON, M. W. 1904. *Smiths. Misc. Coll.*, XLV, pp. 321-447.
- MAJOR, C. J. F. 1899. *Trans. Linn. Soc. London*, (2) VII, pp. 433-520.
- MARGRAVE, G. 1648. '*Hist. Rerum Nat. Brasil*,' pp. 223-224.
- MATSCHE, P. 1894. *Sitz.-ber. Ges. Naturf. Freunde*, pp. 57-64.
- MILLER, G. S., JR. 1898. *Proc. Biol. Soc. Wash.*, XII, pp. 97-98.
- MOLINA, J. I. 1782. '*Sagg. Stor. Nat. Chili*,' 1st Ed.
- NELSON, E. W. 1904. *Proc. Biol. Soc. Wash.*, XVII, pp. 103-110.
1909. '*North Amer. Fauna*,' No. 29.
- OSGOOD, W. H. 1910. *Field Mus. Nat. Hist. Publ.*, Zool. Ser., X, pp. 23-32.
1912. *Field Mus. Nat. Hist. Publ.*, Zool. Ser., X, pp. 33-66.
1914. *Field Mus. Nat. Hist. Publ.*, Zool. Ser., X, pp. 143-185.
- PALLAS, P. S. 1778. '*Nov. Spec. Quadr. e. Glirium ordine. . .*,' p. 30.
- PELZELN, A. VON. 1883. *Verh. Zool. Bot. Ges. Wien*, XXXIII, anhang.
- POCOCK, R. I. 1925. *Proc. Zool. Soc. London*, pp. 669-700.
- RAY, J. 1693. '*Synopsis meth. Anim. Quadr.*,' pp. 205-206.
- RENGGER, J. R. 1830. '*Naturg. Säug. Paraguay*.'
- ROBINSON, W. 1896. *Proc. U. S. Nat. Mus.*, XVIII (1895), p. 651.
- STONE, W. 1914. *Proc. Ac. Nat. Sci. Phila.*, LXVI, pp. 9-19.
- THOMAS, O. 1882. *Proc. Zool. Soc. London*, pp. 98-111.
1897. *Ann. Mag. Nat. Hist.*, (6) XX, pp. 544-552.
1900. *Ann. Mag. Nat. Hist.*, (7) V, pp. 354-357.
- 1901a. *Ann. Mag. Nat. Hist.*, (7) VII, pp. 541-555.
- 1901b. *Ann. Mag. Nat. Hist.*, (7) VIII, pp. 526-536.
- 1901c. *Ann. Mag. Nat. Hist.*, (7) VIII, pp. 536-539.
1903. *Proc. Zool. Soc. London*, II, pp. 232-244.
1904. *Ann. Mag. Nat. Hist.*, (7) XIV, pp. 33-37.
1911. *Proc. Zool. Soc. London*, pp. 120-158.
1913. *Ann. Mag. Nat. Hist.*, (8) XI, pp. 209-214.

1914. *Ann. Mag. Nat. Hist.*, (8) XIV, pp. 410-414.
1918. *Ann. Mag. Nat. Hist.*, (9) I, pp. 186-193.
1920. *Ann. Mag. Nat. Hist.*, (9) V, pp. 31-33.
1921. *Ann. Mag. Nat. Hist.*, (9) VIII, 442-443.
1927. *Ann. Mag. Nat. Hist.*, (9) XIX, pp. 361-373.
- TOMES, R. F. 1860. *Proc. Zool. Soc. London*, p. 260.
- TROUESSART, E.-L. 1881. *Bull. Soc. Etudes Scient. Angers*, (1880), pp. 58-212.
1898. 'Cat. Mamm. viv. foss.'
1905. 'Cat. Mamm. viv. foss.' Supplement.
1910. *Miss. de l'Equateur Paris*, IX, pt. 1, pp. 1-31.
- TSCHUDI, J. J. VON. 1845. 'Untersuchungen Fauna Peruana.'
- WATERHOUSE, G. R. 1843. 'Nat. Hist. Mammalia,' II, pp. 1-146.
- WIED, M. A. 1825-1833. 'Beiträge z. Naturg. v. Brasilien, II,' pp. 416-473.
- WINGE, H. 1888. *E. Mus. Lundii*, I.

59.53, 84 (729.5)

FOUR NEW SPECIES OF DECAPOD CRUSTACEANS FROM
PORTO RICO¹BY WALDO L. SCHMITT²

Representatives of three new species of shrimps, one constituting a new genus, and a new hermit crab were found among the Crustacea obtained by the expedition of the New York Academy of Sciences to Porto Rico in 1915, and are described in the present paper under the following names: *Synalpheus osburni*, *Periclimenes portoricensis*, *Gnathophylloides* (new genus) *mineri*, and *Paguristes tortugae*.

Synalpheus osburni, new species

Figure 1

Apparently an undescribed species of the *laevimanus* group, belonging among the species in which the scaphocerite is represented by the spine alone, no trace of the blade remaining, at least in the female sex.

DESCRIPTION.—The frontal margin like *S. rathbunae* suggests *S. goodei*, but the rostral projection is so much longer than the lateral projections that it sets this species quite apart from those to which it seems most nearly related. The antennular articles are related to one another about as 3, 1.5, 1. The superior angle of the basicerite forms a well-marked subacute tooth or spine about in line with the extremities of the lateral projection of the front; though relatively much less developed than in *S. rathbunae*, the development is greater than in other American "*laevimanus*" species, with the possible exception of *S. goodei*, which differs, however, in having the scaphocerite furnished with a scale or blade in both sexes, besides having the tubercle on the palmar border of the large chela of different shape and armature. The spine of the scaphocerite exceeds the antennular peduncle a little, while the carpcerite exceeds it by nearly twice the length of its distal article.

The large chela has a blunt, forwardly directed tubercle on the palmar border, and with considerable magnification a small spine, directed obliquely downward, may be observed on its lower side. The carpus of the small cheliped is a little less than half the length of the chela; the fingers are more or less two-toothed distally, there being a slight notch and adjacent low, scarcely perceptible tubercle near the extreme tip of either finger.

Distally, the telson narrows markedly and is armed dorsally with two pairs of large prominent spines; the posterior border likewise carries four stout spines of which the outer pair is the shorter; between the median pair there are in a lower row four long slender spines, secondarily feathered; above these, likewise inserted on the posterior margin but in an upper row, are two pairs of shorter, more slender, naked

¹Published with the permission of the Secretary of the Smithsonian Institution.²Curator of Marine Invertebrates, U. S. National Museum.

setae of which the outer pair is the longer. The outer margin of the external branch of the uropods is armed above the transverse suture with ten teeth, of which the last two on the right outer blade and the penultimate tooth on the left one seem to have been broken off or injured.

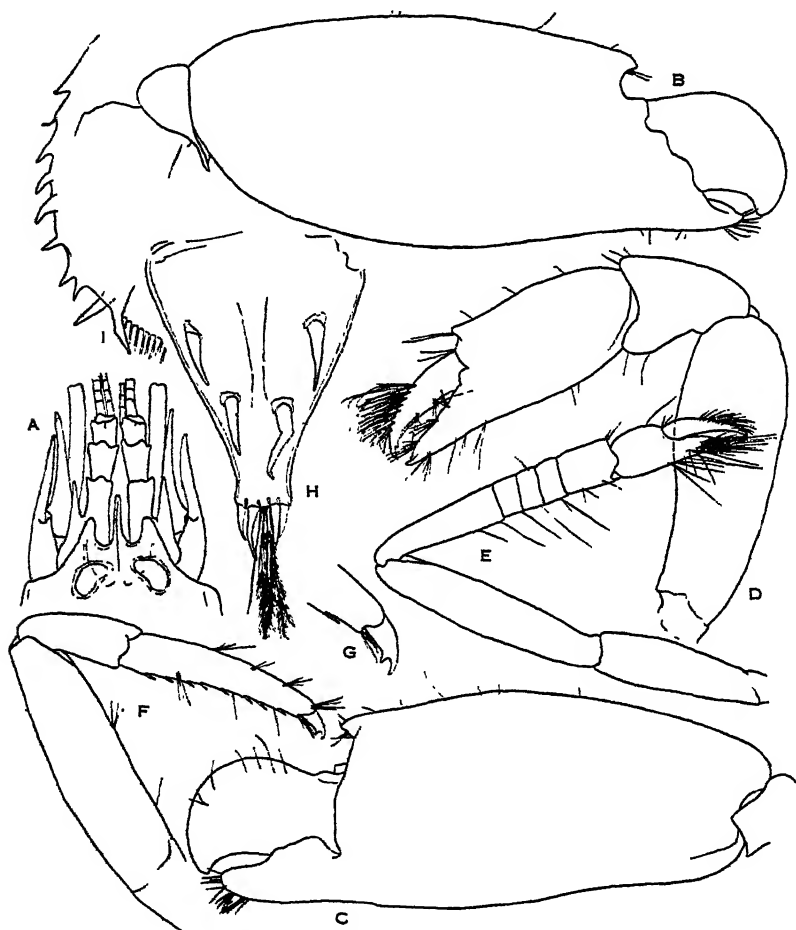


Fig. 1. *Synalpheus osburni*, new species.

a, front from above; b, c, large chela, inner and outer aspects; d, small chela; e, second leg; f, third leg; g, dactyl enlarged; h, telson; i, outer margin of uropod.

TYPE LOCALITY.—The type (Cat. No. 3599, A. M. N. H.), a single ovigerous female with but very few eggs remaining, of approximately 15 mm. in length, was taken from inside Cayo Maria Langa, near Guay-

anilla Harbor, Porto Rico, June 25, 1915, by Dr. Raymond C. Osburn, for whom the species is named.

***Periclimenes portoricensis*, new species**

Figure 2

DESCRIPTION.—A small species that hitherto does not seem to have been recognized or even collected. In Kemp's arrangement of the Pontoninae¹ it keys out in the first section of the subgenus *Ancyllocaris*, among the species without a spine or tooth at the distal end of the lower border of merus of second leg, without supra-orbital and hepatic spines, and with second legs longer than the first. Thus, in his key, it is grouped with *P. pusillus* Rathbun from Hawaii. Our species may be distinguished at first glance from *P. pusillus* by its shorter rostrum and greater number of rostral teeth above and below. In *P. pusillus* the rostrum exceeds the antennular peduncle by nearly the length of the last segment, though possessing but six teeth above and two below; the first of the dorsal teeth is slightly in advance of the hind margin of the orbit.

The rostrum of our species reaches to the middle of the third segment of the antennular peduncle or a little beyond. It is armed above with twelve teeth, of which two are situated on the carapace, and below with three. The more distal inner thickened portion of the basal segment of the antennular peduncle, with which the second segment of the peduncle articulates, is quite well marked off from the thinner external lateral and basal portions of the basal segment, though not separately articulated, as might appear from the accompanying sketch (Fig. 2b); the second and third segments are about the same length, measured on the median line. The fused portion of the outer antennular flagella consists of but two joints; the thicker, shorter ramus has seven free joints and the outer, thinner branch twenty-six; the inner of the two antennular flagella has about twenty-one joints. The antennal scale is about three and two-thirds times as long as wide, the spine and blade reach about equally far forward.

The third maxilliped possesses a strong terminal claw which comprises a full third of the last joint, this, including the claw, is a little longer than the penultimate joint; the antepenultimate joint is nearly as long as the two following taken together, excepting only about half the length of the terminal claw.

I take the dactyl of the third and following pairs of legs to be simple. There is a very slight indication of a lobe, perhaps suggested by the rather slight sinus or very shallow bending in of the ventral margin just before the tip of the dactyl. Though to a slight degree resembling the condition found in *P. noverca* Kemp,² this species in other respects is quite different. If the dactyls were considered comparable to those of *P. noverca*, our species, lacking a hepatic spine, would fall within the subgenus *Periclimenaeus*, none of the known representatives of which it remotely resembles.

The proximal pair of dorsal spines on the telson are inserted at about the middle of its length, the distal pair a little less than half the distance from the proximal pair to the end of the telson; of the three pairs of spines arming the hind margin the median pair is quite slender and is furnished with hairs.

¹1922, *Reo. Indian Mus.*, XXIV, part 2, pp. 119, 137, and particularly p. 167.

²*Op. cit.*, p. 162, Fig. 29d.

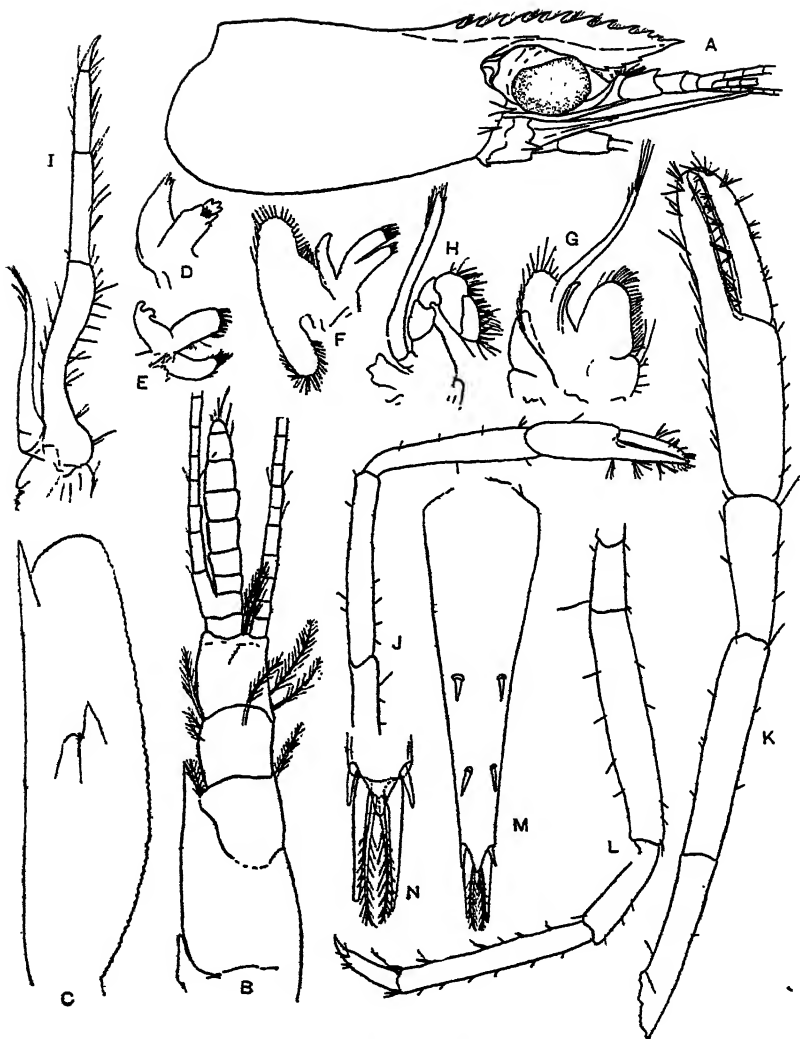


Fig. 2. *Peridimenes portoricensis*, new species.

a, carapace and front, from side; b, antennule; c, antennal scale; d, mandible; e, maxillula; f, maxilla; g, h, i, first, second, and third maxillipeds; j, first leg; k, second leg; l, third leg; m, telson; n, tip enlarged.

TYPE LOCALITY.—Known only from the lone female type (Cat. No. 3676, A. M. N. H.), which is about fourteen and one-half mm. long; carapace and rostrum together about four and one-fifth mm., more or less; from Porto Rico, without specific locality data; taken July, 1914.

GNATHOPHYLLOIDES, new genus

Figure 3

DESCRIPTION.—Closely related to *Gnathophyllum*, *Phyllognathia*, and *Hymenocera*, yet revealing a combination of characters that does not satisfactorily admit its inclusion in any of the three known genera at present constituting the family. General appearance much like *Gnathophyllum*, with a short, compressed and dentate rostrum, but with body not quite so stout; carapace differing from the other members of this genus in that the anterior border on either side, below the antennal spine, is not produced in advance of the spine. The rostrum of the genotype is a little damaged but appears to be armed with three relatively stout, subequal, equidistant teeth behind the acute tip; on the inferior margin there is a small tooth slightly behind the extremity. The condition of the rostrum is such that at a break in the rostrum above the inferior subapical tooth it is not possible to determine definitely whether or not a similar, though very much smaller, tooth may have been present on the upper margin. In a smaller specimen with uninjured rostrum there are, as figured and described above, three teeth, and below a smaller tooth near the tip. The eye is stout and appears to be without the tubercle characteristic of *Gnathophyllum*, which is more or less developed in other representatives of the family. However, it appears somewhat angulated or peaked where the inferior and anterior borders meet.

The outer or third maxilliped conforms in general appearance and structure with that of *Gnathophyllum*, so that on the basis of this character alone the genotype might well have been assigned to that genus. I cannot distinguish the notch or even a suggestion of it marking off the ischium from the merus, as remarked by Borradaile in his characterization of *Gnathophyllum*.¹ The third maxilliped is often indifferently drawn by authors, so a comparison of this point in the various species cannot be made without specimens. The exopodite is considerably longer than the endopodite, and so apparently differs quite markedly from all other gnathophyllids which, so far as I have been able to ascertain, have the exopodite shorter than the endopodite.

The second maxilliped, though not unlike that of *Hymenocera*, most resembles that of *Phyllognathia ceratophthalma*, and distally is quite unlike the "scythe shaped" organ formed by the last two joints of this appendage in *Gnathophyllum*.

The first maxilliped has, likewise, more the appearance of the corresponding appendage in *Phyllognathia* and *Hymenocera* than in *Gnathophyllum*.

In *Gnathophyllum* the maxillula tends to become distally widened or expanded, relatively more so than in our genus where in shape and expansion it is intermediate between the foregoing genus and *Hymenocera* on one hand and *Phyllognathia* on the other. The mandible, likewise, seems to be of an intermediate form.

More striking are the differences exhibited by the legs and the armature of the telson. The second chelipeds have exceedingly short carpal, meral, and ischial joints, and the ambulatory legs as compared with the other genera, are remarkably short

¹Trans. Linn. Soc. London, (2) XVII, part 3, p. 409.

and stout. They lack the relatively longer and characteristically bifid dactyls common to the known species of *Gnathophyllum* and *Phyllognathia*, or the less stout, simple dactyls of the described *Hymenocera*. The dactyls of the ambulatory legs of the genotype are unique within the family: short, stout, somewhat ovoid, armed with a stout terminal claw, immediately beneath which may be found a pair of slender spines, or



Fig. 3. *Gnathophylloides mineri*, new species.

a, carapace, rostrum reconstructed; b, eye; c, antennule; d, antennal scale; e, mandible; f, maxilla; g, maxilla; h, i, j, first, second, and third maxillipeds; k, major chela; l, minor chela; m, first leg; n, ambulatory leg; o, dactyl of same more enlarged; p, telson and uropod of left side.

stout, pointed setae; the lower margin of the dactyl is curved and protrudes a bit distally and is armed throughout with a close-set row, or comb, of low conical spines or blunt teeth. The telson differs from the characterization of this appendage, as given by Borradaile (*loc. cit.*) for the family—"The telson bears two pairs of spines

at the sides, and at the end an outer short and an inner long pair of spines, a submedian pair of feathered spines and a median pointed projection"—inasmuch as the hinder margin of the telson is armed with three pairs of more or less subequal spines. The outer pair of these spines is slightly smaller and the medial pair slightly the larger. In advance of terminal spines, but close to the hinder end, the lateral margins are armed with two small spines on either side.

GENOTYPE.—*Gnathophylloides mineri*, new species.

Gnathophylloides mineri, new species

Figure 3

DIAGNOSIS.—As given in the generic description.

SIZE.—Small, the largest, which is the type specimen (Cat. No. 6700, A. M. N. H.), being about 6 mm. long, of which the carapace and rostrum represent close to two-fifths of the length of the body, approximately 2.3 mm. One of the two paratypes has the carapace and rostrum about 1.8 mm. long.

TYPE LOCALITY.—Known only from three specimens taken from the coral reefs at Ballena Point, Ensenada, Porto Rico, June 12, 1915, by R. W. Miner and H. Mueller.

Paguristes tortugae, new species

Figure 4

Rostrum about as broad as long at the base; of the several species of *Paguristes* figured by Benedict (1901, Pls. iv, v) it is most like *P. spinipes*, though quite different in some respects. Falling among the species with eye-stalks, measured from the extremity of the rostral point to the end of the cornea, shorter than the distance between the anterolateral angles, *P. tortugae* stands nearest *P. puncticeps* but differs in its broader, triangular rostrum, which in *P. puncticeps* is more strap-shaped.

The anterior portion of the carapace is slightly more than one and one-third times as long as the greatest width across the anterolateral angles; the hinder part of the carapace is a little more than half the length of the anterior portion, its length being slightly more than three-fourths the width of the anterior portion.

The eye-stalks exceed the length of the antennular peduncle by about the length of the cornea; the antennular peduncle reaches at least to the middle of the terminal joint of the antennular peduncle or beyond; the eye-scales are armed with three spines of which the innermost is the largest, the middle one subequal to or a little smaller than the first, and the outermost, or third, is much smaller, and well down on the outer slope or margin of the eye-scale; its tip scarcely reaches the level of the bottom of the sinus or interspace between the first two.

All the limbs are bordered by a very striking and characteristic dense fringe of white hairs: on the whole extent of the upper and lower margins of the ambulatory legs, and on the upper, outer border of the chelipeds including the chelae, on which the fringe is continued along the outer margin to the corneous tip of the fixed finger; the hands are pubescent but elsewhere hairs are sparse and not particularly noticeable except for bushy tufts on the antennal scales and the fore edge of the carapace. A feature worthy of note is the fact that the hairs carry side branches on

either side of the main shaft, feather-like; in this character our species is very different from the closely related species, *P. puncticeps* and *grayi* Benedict.

More or less hidden by the thick fringe of hairs, the outer half of the palm and the outer margin of the fixed finger are beset with sharp, forwardly directed, hooked spines, likewise the median area of the upper surface of the palm; inner margin of the hand similarly armed with three stout spines. The movable finger is about one and three-fourths times as long as the inner margin of the palm measured from the articulation. As in *P. puncticeps*, the inner margins of the movable fingers and palms are quite straight, so that the chelae fit closely and snugly together when with-

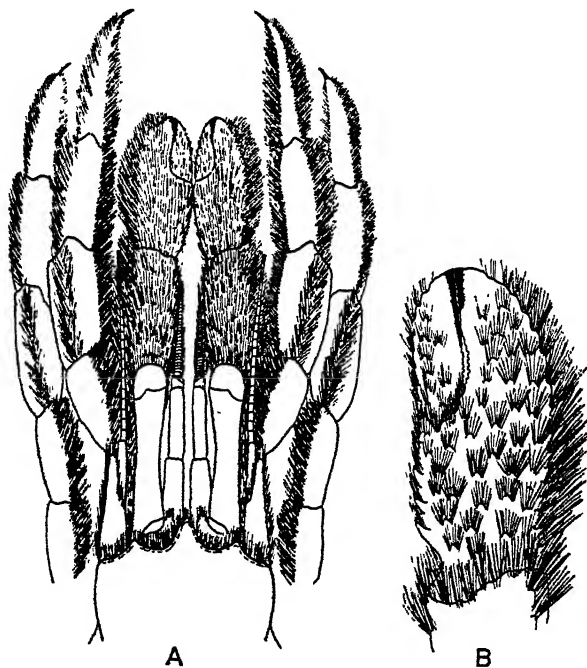


Fig. 4. *Paguristes tortugae*.

a, anterior portion to show fringes of hair and front; b, right chela, with part of pubescence and hairs removed.

drawn into the shell. The carpus of the right cheliped has five large spines on the inner margin, about as many slightly smaller spines on the outer margin, and three or four sharp spines on the anterior margin; the upper surface is more or less coarse-granulate with an approximately median row of sharp conical granules; the carpus is more than one and one-half times longer than its greatest width, thus being longer and narrower than the corresponding joint in *P. puncticeps* and *grayi*; in *puncticeps* it is about as wide as or slightly wider than long at the anterior end, and in *grayi* but very little longer than the greatest width. The merus is armed with a sharp

corneous-tipped spine near the anterior end of the upper margin and three good, sharp, corneous-tipped spines on the anterior margin; otherwise general surface of joint is more or less scabrous, inner lower margin armed with three or four sharp spines.

The merus of the first right ambulatory leg is denticulated on the anterior margin; the carpus has a row of conical spines or tubercles on the upper margin and a somewhat irregular second row on the inner face, in line with a similar row of seven to nine spines on the inner face of the propodus, the upper margin of which is armed with seven to eight conical, light corneous-tipped spines. About fifteen transverse tuberculiform ridges ornament the upper margin of the dactyl which terminates in a strong, dark blackish-brown corneous claw. The opposite leg is similar but less prominently spined, while the second pair of ambulatory legs are quite without spines except two not very conspicuous ones among the hairy fringe, one at and the other close to the anterior end of the upper border of the carpus. The carpus is obscurely denticulate on the upper border, but this pair of legs, though somewhat scabrous, is quite smooth in comparison to the first pair.

TYPE LOCALITY.—Because of its larger size, an ovigerous female (Cat. No. 65840, U. S. N. M.), taken from the interstices of large *Porites* clumps off the Fort Jefferson dock, Garden Key, Dry Tortugas, Florida, July 13, 1931, in company with several other specimens of the same species, has been selected as the type. The anterior, hard portion of the carapace of this female measures five mm. long.

DISTRIBUTION.—At present known only from the Dry Tortugas and Porto Rico as noted below, but no doubt to be found more widely distributed through the south Floridian and West Indian region.

SPECIMENS COLLECTED.—Ensenada: entrance Guayanilla Harbor, 5; entrance Montalva Bay, 1; mangrove island at Parguera, 1. Near Guanica, 1.

AMERICAN MUSEUM NOVITATES

Number 663

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Sept. 27, 1933

56.9, 74 P (495:22)

A FOSSIL SKUNK FROM SAMOS

BY GUY E. PILGRIM

In 1924, Mr. Barnum Brown, representing the American Museum of Natural History, made several excavations for the purpose of obtaining fossil vertebrates in the Aegean Island of Samos near the classic site north of the village of Mytilini. There Forsyth Major in 1887 and 1889 had collected the first fossils which he subsequently made known to the scientific world. Other collections have, from time to time, been made since then, and partially described, but much remains to be done on Major's original material as well as on the later finds.

The specimen which forms the subject of the present paper is in Mr. Barnum Brown's Samos collection and through his kindness was entrusted to me for description. It consisted of the conjoined skull and mandible which have been skilfully disunited by Mr. Albert Thomson with a minimum damage. It is by far the most perfect specimen of a fossil skunk skull known and may be referred to the extinct genus *Promephitis*, which was established by Gaudry for a specimen from Pikermi. It represents a new species of that genus, to which the name *majori* may be affixed in honor of the distinguished palaeontologist to whom we owe the discovery of the Samos deposit.

The fossil fauna of Samos has long been recognized as approximately contemporaneous with that of Pikermi, and has been assigned to the Pontian stage, which according to the most general opinion is included in the Lower Pliocene.

Pocock (1921, p. 82X) has advocated the separation of the mustelid genera, *Mephitis* and its allies, as a subfamily distinct from the Melinae, in which they were formerly included. In a recent paper (Pilgrim, 1933, p. 864) I have adduced additional arguments in favor of this and have associated in a single subfamily, Mephitinae, the Javan genus *Mydaus* with the living skunks, which have been divided into the three genera *Mephitis*, *Conepatus*, and *Spilogale*, as well as the fossil genera *Brachyprotoma* Brown, *Promephitis* Gaudry and *Trocharion* Major.

PROMEPHITIS Gaudry, 1861

Promephitis GAUDRY, 1861, C. R. Acad. Sci., Paris, LII, p. 722.

GENOTYPE.—*Promephitis lartetii* GAUDRY, 1861, C. R. Acad. Sci., Paris, LII, p. 722; 1862, Anim. Foss. Attique, p. 46, Pl. VI, figs. 5–7.

DIAGNOSIS.—Mephitinae with short, broad occiput; face broad and especially shortened; brain case more or less flattened; auditory bulla much depressed; mastoid and paroccipital processes strong; zygomatic arch strongly curved; palate not extended behind the last molars; premolar series reduced; P^1 absent; P^2 absent or vestigial; P^4 long, with protocone not extending more than half the length of the tooth; M^1 transverse greater than anteroposterior diameter, anteroposterior diameter equal to or less than that of P^4 ; mandibular ramus robust, deep, symphysis gradual; P_1 absent; M_1 much longer than premolar series, talonid approximately equal to trigonid, paraconid slightly oblique to protoconid, metaconid strong, slightly lower than protoconid, entoconid low, ridge-like; M_2 small round, single-rooted, crown basin-shaped, with one or two low cusps internally and externally.

Promephitis majori, new species

?*Promephitis lartetii* GAUDRY, Major, 1894, Le gisement ossifère de Mytilini, No. 334, p. 29.

TYPE.—Amer. Mus. No. 20585, and associated skull and mandible.

HORIZON AND LOCALITY.—Quarry I near old German excavations, district Adrianos on property owned by the Soufoulis family. About $1\frac{1}{2}$ miles north of the village of Mytilini. Approximately in the middle of the Pontian strata.

DIAGNOSIS.—A *Promephitis* of smaller size than the hitherto known species; skull with upper profile more convex than *P. maeotica*; stronger post-orbital processes; occipital condyles less prominent; M^1 transverse diameter less than in *P. maeotica* or *P. lartetii*, anteroposterior diameter equal to instead of less than that of P^4 ; P^4 with a pronounced parastyle; P^1 and P^2 both absent; mandibular ramus with lower border not straight, but stepping up to the angle behind the level of the last molar; M_1 without the external cingulum of *P. maeotica* and *P. alexejewi*.

DESCRIPTION.—The skull and mandible are almost perfect, quite uncrushed, and lack no essential part. They belonged to an individual which had attained the adult state some time previous to its death, since the sutures are completely obliterated and all the teeth show considerable signs of wear. A crystalline matrix still fills some of the smaller cavities, from which it has proved difficult to remove it without injury to the specimen, and its presence obscures many of the foramina and some of the details of the surface. The right P^4 has only the inner edge of the protocone preserved and the left P^4 has lost the antero-external corner of the tooth, so that the presence of a parastyle can only be inferred by the fairly considerable space occupied by the anterior part of the root which has been broken off at the very base of the crown. The mandible is complete except for the right angle and condyle, the tip of both coronoid processes, the postero-external corner of the left M_2 ,

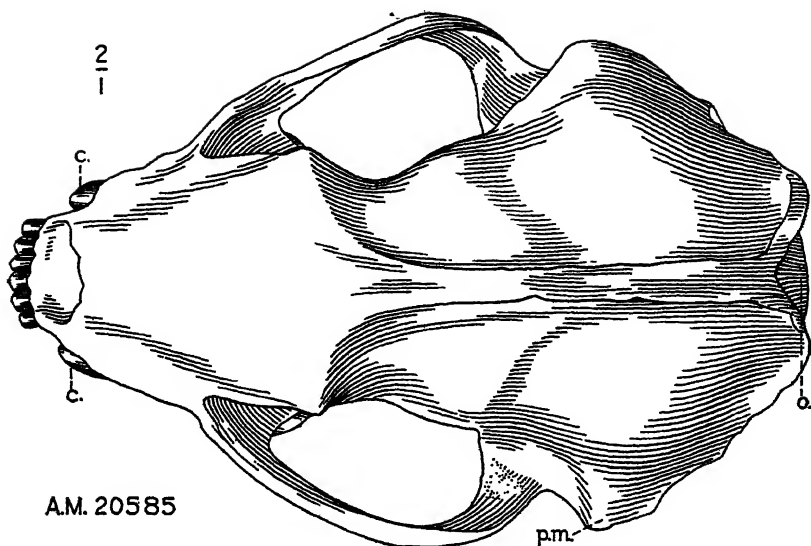


Fig. 1. *Promephitis majori*, A. M. N. H. No. 20585. Top view of skull. Twice natural size. c., canine; p.m., mastoid process; o., occipital.

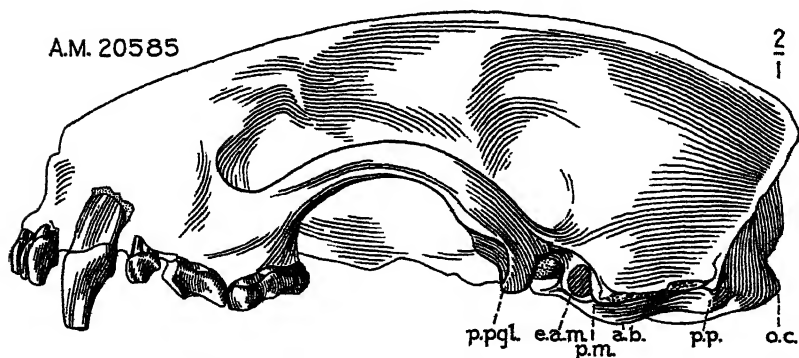


Fig. 2. *Promephitis majori*, A. M. N. H. No. 20585. Left side of skull. Twice natural size. p.pgl., processes postglenoideum; e.a.m., external auditory meatus; p.m., mastoid process; a.b., auditory bulla; p.p., paroccipital process; o.c., occipital condyle.

the inner edge of the right M_1 including the summit of the protoconid and the whole of the metaconid, and the right I_1 .

SKULL.—The skull (figs. 1, 2) is short, as in all the living genera of skunks, the face partaking in the general shortening. The face in the Samos skull has, however, shortened more than in the genera *Mephitis* and *Conepatus* and agrees with that of *Spilogale*. The upper profile is gently arched, little less so than in *Mephitis* and *Conepatus*. *Spilogale* on the other hand has an almost straight profile. *Promephitis maeotica* seems to be intermediate between *P. majori* and *Spilogale*. From the mastoid region the brain case narrows rather rapidly to a point about 6 mm. behind the postorbital processes, and then the skull expands up to the rather strongly marked postorbital processes, gradually contracting forward to the end of the muzzle. This is like *Spilogale arizonae*, except that in the latter the skull is as a whole more slender and the postorbital processes more prominent. In both *Conepatus* and *Mephitis* the contraction behind the orbits and the expansion of the lower part of the brain case in the mastoid region are less marked, while the postorbital processes are almost or quite absent. Except for the weaker postorbital processes, *P. maeotica* seems to agree very closely with the Samos skull. The expansion of the brain case at the mastoid, combined with the abbreviation of the bulla and the glenoid, causes the angle included between the hinder edge of the zygomatic process of the squamosal and the margin of the skull just behind it to be acute, whereas in all the living genera this angle is either very obtuse or changed into a broad, rounded curve. The zygomatic arches are slender, and strongly bent upward, with the highest point at the middle of the arch. This is almost the same as in *Spilogale*. In *Mephitis* the upward curve is much less and the highest point of the arch lies somewhat behind the middle. In *Conepatus* the zygomatic arch is almost horizontal. The zygomatic arch projects outward but little beyond the mastoid process. In both *Mephitis* and *Conepatus* the width at the zygoma is much greater than at the mastoid.

Spilogale is narrower, and if its mastoid process were as prominent as in *P. majori*, there would be no difference in the width at the zygoma between them. In both of them, moreover, the zygomatic process juts out much more nearly at right angles to the axis than in *Mephitis* and *Conepatus*, while the temporal opening enclosed by the zygomatic arches and the brain case is wide relative to its length, in contrast to its much greater elongation in *Mephitis* and *Conepatus*. The orbit is rather narrow and elongate and its anterior end is opposite the hinder end of P^4 . The infra-orbital foramen occupies the middle of a rather large, shallow fossa,

which is closely adjacent to the anterior edge of the orbit. The nasals extend rather far forward, so that the anterior narial foramina have a very small opening onto the upper surface of the muzzle, but face almost entirely forward, thus resembling *Spilogale* and *Mephitis* but differing greatly from *Conepatus*. Their shape on the palate is small and round as in *Spilogale*. The brain case (fig. 3) is markedly depressed, though less so than in *Spilogale*. It is higher and more arched in *Mephitis* and still more so in *Conepatus*. The sagittal crest is strong and broader than in any of the living genera, dividing into two branches which form the lambdoid crest some little way in front of the occipital crest. The lambdoid crest thus runs forward on each side of the median line as it approaches its highest point, so as to form a V-shaped outline when seen from above.

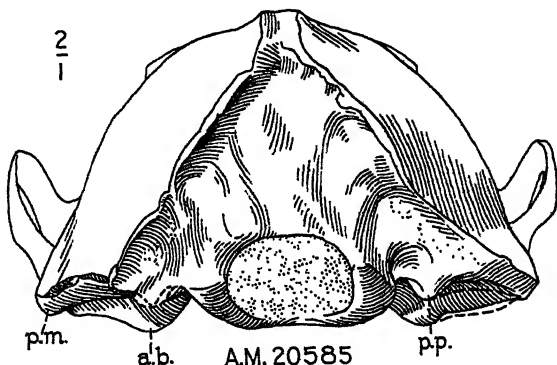


Fig. 3. *Promephitis majori*, A. M. N. H. No. 20585. Occipital view of skull. Twice natural size. p.m., mastoid process; a.b., auditory bulla; p.p., paroccipital process.

This character is much less noticeable in *Spilogale*, still less so in *Mephitis*, while in *Conepatus* the direction of the lambdoid crest is normal. The shape of the occipital as bounded by the prominent lambdoid crest is that of an inverted V, of which the angle is slightly less than a right angle; in *Spilogale* it is greater than a right angle, while in most species of *Mephitis* and *Conepatus* the occipital is of a semicircular shape. The occipital condyles are rather more prominent than in the living genera, and oblique, enclosing a larger foramen magnum than in the living genera. The basioccipital is extremely wide as in *Mephitis* and *Conepatus*, and much more so than in *Spilogale*. The mastoid process is very strong and projects outward almost as much as in *Conepatus* and *Mephitis*. In *Spilogale* it is much weaker. The paroccipital process is strong and much

expanded transversely at its base; it extends downward as far as the summit of the auditory bulla, thus forming an abrupt boundary between the tympanic and occipital regions as in *Mephitis*, unlike *Spilogale*, in which the paroccipital process is feeble and the passage from the tympanic into the occipital area is gradual. In *Conepatus* the passage is also gradual, except for the rather prominent but narrow paroccipital process. The auditory bulla is narrow and much depressed; its summit is but little lower than that of the meatal tube. This is a marked feature of

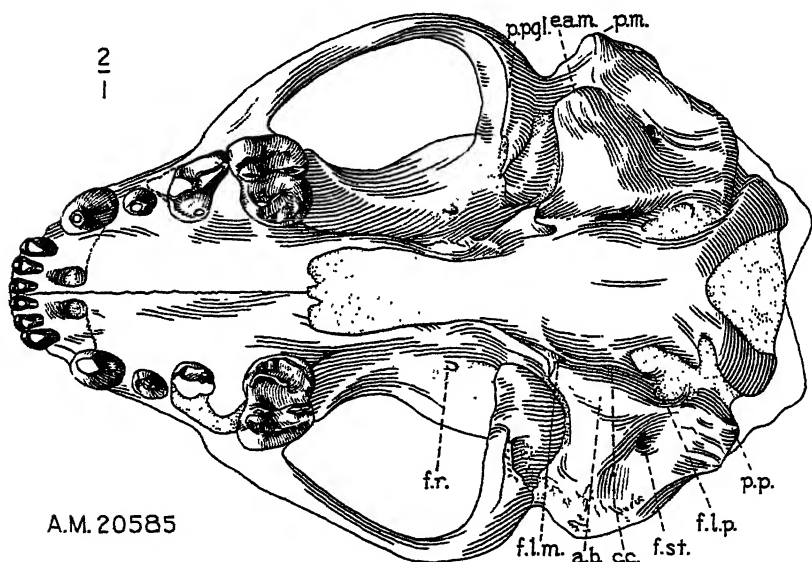


Fig. 4. *Promephitis majori*, A. M. N. H. 20585. Ventral view of skull. Twice natural size. p.pgl., processes postglenoideum; e.a.m., external auditory meatus; p.m., mastoid process; f.r., foramen rotunda; f.l.m., foramen lacerum medium; a.b., auditory bulla; c.c., carotid canal; f.s.t., foramen stylomastoideum; f.l.p., foramen lacerum posterius; p.p., paroccipital process.

difference from all the living genera, but especially so from *Spilogale*. The bulla (fig. 4) is short as in *Mephitis* and does not reach as far forward as the post-glenoid crest. The meatal tube is for the most part directed laterally and only very slightly forward, thus differing from all the living genera but most of all from *Spilogale*. The stylomastoid foramen is of moderate size and lies rather far back, being almost on the same level as the foramen lacerum posterius. As in *Conepatus* there is a large foramen

on the postero-internal side of the bulla which probably includes, as in the living genus, the foramen lacerum posterius and the condylar foramen. In *Mephitis* and *Spilogale* these foramina are smaller. In front of these and opposite the middle of the bulla is the posterior opening of the carotid canal, which apparently again emerges at the anterior end of the bulla where the foramen lacerum medius is well shown. The glenoid cavity is small; it is surmounted but not much overhung by the prominent, rather vertical post-glenoid crest which slopes steeply backward in a very different fashion from the almost horizontal position which it occupies in all the living genera. The palate is broad and as in *Mephitis* and *Spilogale* does not extend backward beyond the hinder edge of the last molar. In *Conepatus* it is prolonged somewhat farther.

UPPER DENTITION.—Incisors increasing in size from I^1 to I^3 ; I^3 much the largest of the three. All the incisors expanded behind at the base, as much as in *Conepatus*. Canine of normal size, high-crowned with elongate, oval cross-section at base, with small posterior basal cusp and a faint antero-internal cingulum. Diastema of about 5 mm. behind the canine. P^1 and P^2 absent; P^3 small, two-rooted, with broadly oval cross-section and slight cingular cusp behind; P^4 relatively longer than

in the living genera, length equal to or perhaps slightly greater than that of M^1 ; with a pronounced parastyle broken off so that its height is unknown and its length can only be estimated by the forward extension of the root; paracone high but without its summit; metacone a shearing

blade, lower than the paracone, but almost half the entire length of the tooth; protocone with a moderately great transverse extension, but antero-posteriorly extending only about half the length of the tooth, with a prominent cusp at the postero-internal corner, but without a posterior cingulum, so that unlike the living genera the passage into the faint cingulum on the inner side of the metacone is very abrupt. In *Spilogale* and *Mephitis*, a broad posterior cingulum, passing gradually into that on the internal side of the metacone, gives the protocone a triangular shape. In *Conepatus* the protocone extends almost the entire length of the tooth so as to be almost lutrine in appearance. In front of the cusp is a broad basin-shaped cingulum which passes rather abruptly into the parastyle. M^1 antero-posterior less than transverse diameter and about equal to or slightly less than that of P^4 . M^1 (fig. 5)

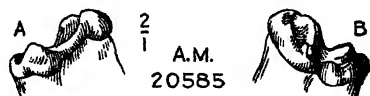


Fig. 5. *Promephitis majori*, A.M.N.H. No. 20585. A, front view of M^1 . B, rear view of M^1 . Twice natural size.

is approximately square or with slightly inferior antero-posterior diameter in *Mephitis* and *Spilogale*, and in *Conepatus* the antero-posterior diameter is greater than the transverse diameter; metacone as long as paracone but lower; parastyle distinct but weaker than in living genera, metastyle practically absent; protocone forming a crescentic ridge which terminates at little more than half-way across the crown; pronounced internal cingulum, very faint at the antero-internal angle but widening out posteriorly into a broad basin-shaped valley which extends to the base of the metacone; pronounced external cingulum. The external wall of the tooth is much more oblique to the axis of P^4 than is the case in *Mephitis* and *Spilogale*. This is partly due to the presence of a strong metastyle in the living genera.

MANDIBLE.—Compared with *Spilogale arizonae*, which is approximately the same-sized animal, the mandible (fig. 6) is rather more robust and shorter with smaller canines and shorter P_2 . In *Mephitis* and *Conepatus* the mandible is relatively even longer. The depth of the ramus exceeds that of any of the recent genera. Its lower border is straight up to the hinder end of M_2 and then steps up to the angle, as in *Mephitis* and *Conepatus*. In *Spilogale* the lower border of the ramus is horizontal or slightly convex from symphysis to angle, and apparently the same is the case in *Promephitis lartetii* and *P. maeotica*. The symphysis is rather gradually sloping, much as in *Spilogale*; it is flatter in *Conepatus*. The coronoid process ascends very steeply and is very high, though the top is missing. The condyle is rather near the angle and does not lie far behind it. The angle is club-shaped as in *Conepatus*, and not so pointed as in *Mephitis* and *Spilogale*.

LOWER DENTITION.—Incisors of equal size and in the same line. In living genera they are apt to differ from one another. Thus in *Conepatus* and *Spilogale arizonae*, I_2 is larger and more backwardly placed than the other two. In some species of *Mephitis*, both I_2 and I_3 are somewhat larger than I_1 . Canine very concave behind, slenderer than in living genera, with well marked internal cingulum but practically no posterior cusp. No diastema behind the canine. P_1 absent, P_2 minute, (?) one-rooted; P_3 with oval cross-section expanded at the postero-internal corner and with a slight cusp; anterior keel straight; main posterior keel concave, P_4 like P_3 but larger. The premolars lie more obliquely in the jaw than in *Spilogale* or *Mephitis*, but less so than in *Conepatus*. In *Conepatus* they have stronger inner cingula and cingular cusps and there are diastemata between the first three premolars and behind the canine. M_1 length much greater than the depth of the ramus and much exceeding

that of the premolar series. In this respect it is strikingly different from all the living genera, in which M_1 is either equal in length to or slightly less than the premolar series; trigonid a little longer than talonid; paraconid not very oblique to protoconid, as long as protoconid but lower; metaconid strong but lower than protoconid and almost on the same level with it. In *Spilogale* and *Mephitis* the position of the paraconid is about

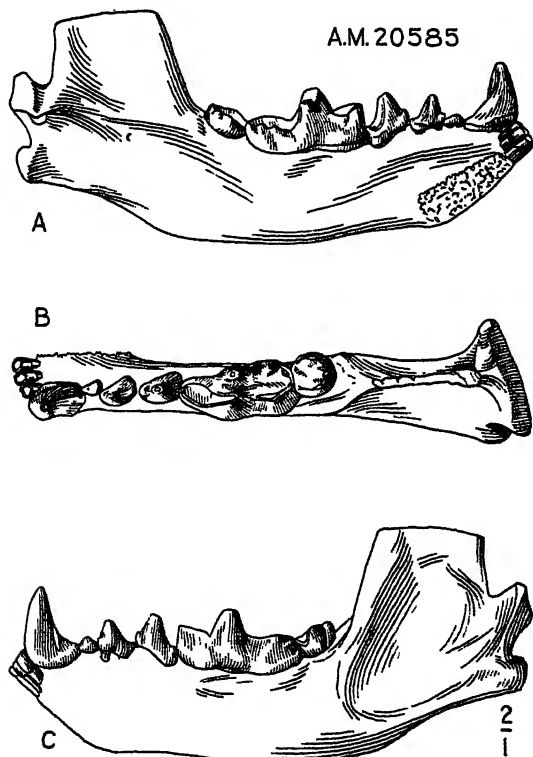


Fig. 6. *Promephitis majori*, A. M. N. H. No. 20585. A, left lower jaw, inner view. B, left lower jaw, crown view. C, left lower jaw, outer view. Twice natural size.

the same but the metaconid is somewhat higher. In *Conepatus* the paraconid is shorter and much more oblique; the metaconid is higher and the trigonid is no longer, sometimes much shorter than the talonid. The talonid in *Promephitis majori* is basin-shaped, having a trenchant hypoconid somewhat worn, and an entoconid on which two low cusps are

MEASUREMENTS OF FOSSIL MEPHITINAE

	<i>Promephitis majori</i>	<i>Promephitis masatica</i>	<i>Promephitis alecejevi</i>	<i>Promephitis larteki</i>	<i>Promephitis malutenensis</i>	<i>Brachypodoma pristina</i>
Length of skull from occipital condyles to front edge of incisors.....	53.6	67.5	....	70.0	....	46.0
Distance from front edge of orbit to front edge of incisors.....	17.4	....	....	19.0	....	....
Distance from front edge of orbit to occipital condyles.....	39.1	....	....	50.0	....	....
Distance from lower edge of foramen magnum to front edge of incisors...	44.5	59.7	....	....	....	....
Distance from lower edge of foramen magnum to hinder end of palate....	27.5	36.0	....	....	....	....
Distance from hinder end of palate to hinder end of middle incisors.....	18.0	23.7	....	....	....	....
Breadth of skull at mastoid processes..	33.0	44.0	....	....	....	....
Breadth of skull at zygomatic arches...	37.0	....	....	....	....	....
Minimum breadth of skull behind post-orbital processes.....	14.7	16.6	....	....	....	....
Breadth of skull between post-orbital processes.....	17.3	24.0	....	....	....	....
Minimum breadth of skull between orbits.....	16.6	22.0	....	....	....	....
Breadth of skull at canines.....	14.0	18.2	....	....	....	app. 21.0
Breadth of palate between hinder ends of P ⁴	16.3	....	....	....	....	....
Height of skull from occipital condyles to highest point of occiput.....	20.0	24.4	....	....	....	....
Diameter of orbit.....	8.5	12.0	....	....	....	....
Length of entire row of incisors.....	7.5	9.6	....	....	....	....
Distance from front edge of canine to hinder end of M ¹	17.1	21.4	....	26.0	....	app. 15.5
Distance from hinder end of canine to front end of P ⁴	3.0	3.1	....	....	....	3.0
Upper canine	Antero-posterior diameter at base.....	3.5	4.8	....	....	app. 3.8
	Transverse diameter at base.....	2.3	3.3	....	....	2.4
	app.	5.0	9.7	7.0	....	....
	Height of crown.....	5.0	9.7	7.0	....	....
P ³	Antero-posterior diameter.....	2.0	2.5	....	....	....
	Transverse diameter...	1.6	2.0	....	....	....

MEASUREMENTS OF FOSSIL MEPHITINAE

		<i>Promephitis majori</i>	<i>Promephitis maetica</i>	<i>Promephitis decejavai</i>	<i>Promephitis lartetii</i>	<i>Promephitis mahutenensis</i>	<i>Brachypromacia pristina</i>
P ⁴	Antero-posterior diam- eter for <i>P. majori</i> (estimated).....	5.6	7.1	8.0	8.0	....	app. 6.0
	Transverse diameter..	4.1	5.3	5.0	....	....	app. 4.3
M ₁	Antero-posterior diam- eter.....	5.6	5.7	5.8	5.0	....	3.7
	Transverse diameter..	6.5	9.1	7.6	8.0	....	5.7
Distance between mandibular condyles and front edge of incisors.....		35.0	38.7?	....	....	....	30.5
Distance from front edge of canine to hinder end of M ₂		19.7	26.0	....	25.0	....	....
Distance between hinder end of canine and front end of M ₁		6.0	app. 8.0	....	8.0	app. 14.5	6.5
Distance between angular process and top edge of condyle.....		6.6	app. 7.5	....	....	....	....
Depth of mandibular ramus beneath middle of M ₁		7.0	app. 8.5	app. 8.0	....	app. 7.0	5.8
Lower canine	Antero-posterior diam- eter at base.....	3.5	....	....	....	....	....
	Transverse diameter at base.....	1.8	....	....	....	....	....
	Height of crown (meas- ured from hinder end of base along concave keel).....	4.5	....	9.0	....	....	....
P ₂	Antero-posterior diam- eter.....	.9	....	....	....	....	....
	Transverse diameter..	.6	....	....	....	....	....
P ₃	Antero-posterior diam- eter.....	2.0	....	....	....	....	....
	Transverse diameter..	1.4	....	....	....	....	....
P ₄	Antero-posterior diam- eter.....	3.0	....	3.8	....	....	....
	Transverse diameter..	2.0	....	2.0	....	....	....
M ₁	Antero-posterior diam- eter.....	7.9	10.2	10.6	8.0	9.0	7.4
	Transverse diameter..	3.5	4.7	4.8	....	3.5	....
	Length of trigonid....	4.5	....	5.6	....	....	....
	Length of talonid....	3.3	....	5.0	....	....	....
M ₂	Antero-posterior diam- eter.....	2.4	....	....	....	....	....
	Transverse diameter..	2.4	....	....	....	....	....

apparent with a trace of a faint one behind them. *Spilogale* agrees with *P. majori* in the lowness of the entoconid, but the single entoconid cusp in *Mephitis* is much higher, and one of the two present on the entoconid of *Conepatus* is equally high. M_2 is small, approximately round, slightly pointed behind, with one or two cusps both on the internal and on the external side, in both cases indicated by a ridge of somewhat advanced wear. At the posterior end of the crown is another low cusp not much worn. The structure of M_2 seems to be not unlike this in the living genera. In *Conepatus* the outline is almost the same; in *Mephitis* and *Spilogale* it is more elongate, tending towards *Mydaus* and *Trocharion*.

AFFINITIES.—The genus *Promephitis* has already been recorded from Samos by Major (1894, No. 334, p. 29), as a fragmentary ramus, which he referred to *P. lartetii*. It is possible that it really belongs to *P. majori*, but since I cannot recall its dimensions or any special features about it, its exact specific determination must remain doubtful.

The genotype of *Promephitis* is *Promephitis lartetii* Gaudry (1862, p. 46, Pl. VI, figs. 5–7), from Pikermi. *P. maeotica* Alexejew (1915, p. 368) from Southern Russia and *P. alexejewi* Schlosser (1924, p. 11) from Mongolia have more or less provisionally been referred to the same genus. Unfortunately the holotype and only known specimen of *P. lartetii* has been so much crushed and has sustained such damage, that it must be very dangerous definitely to identify any other fossil mephitine with it, even generically. Both Alexejew (1915, p. 371) and Schlosser (1924, p. 12) seem to have been unaware of the condition of the Pikermi specimen, and the latter author has naturally expressed considerable doubt as to whether *P. maeotica* and *P. alexejewi* belonged to *Promephitis*. In the circumstances, I think it is possible that the differences of these two species from *P. lartetii* may be really less than Alexejew and Schlosser imagine, so that I am even less inclined than they to establish a new genus for them.

It is easy to compare the Samos specimens effectively with *Promephitis maeotica*, since both the skull and mandible on which that species was established are moderately well preserved. The comparison reveals so many similar features which indicate a stage of development quite different from any of the living genera that I think it would serve no useful purpose to separate them generically. Even by zoologists, the points in which they differ might hardly be regarded as sufficient for generic distinction, and in the case of Pontian species it seems more appropriate to view them as evidence for the existence merely of two different species of the same genus.

The most important features in which these two species resemble each other are the following: 1, a short, broad face and occiput; 2, a similar side and back profile; 3, brain case low and flattened; 4, auditory bulla much depressed and similar in size and position of the meatal tube; 5, strong mastoid process; 6, elongate orbit; 7, palate not extended backward beyond the last molar; 8, premolar series reduced; 9, large P^4 and M_1 ; 10, P^4 with similar protocone not triangular, nor extending more than half the entire length of the tooth; 11, M_1 similar in shape, with metaconid strong but lower than protoconid, entoconid low; 12, M^1 having transverse greater than antero-posterior diameter; 13, M_1 small and round.

There are two differences between these species which might conceivably be considered as of generic significance. It will be seen that although relative to their size P^4 is equally large in both, M^1 has a much greater antero-posterior diameter and a much smaller transverse diameter in *P. majori*. The great excess of the latter dimension in *P. maotica* is largely due to the great development of the internal cingulum which may be comparable to what exists in the genus *Conepatus* and therefore a progressive feature. On the contrary, in *Brachyprotoma pristina* (Brown, 1908, p. 178) the similar excess of the transverse diameter in M^1 is independent of the internal cingulum, and the shape of this tooth seems to be really extremely primitive. The difference between the antero-posterior and transverse diameters is less marked in *P. lartetii* and *P. alexejewi*, but nevertheless is more so than in *P. majori*. One must, therefore, infer that *P. majori* represents a slightly more advanced stage than the other three species. The other difference is that in *P. maotica* and in *P. lartetii* the lower border of the ramus seems to be straight, instead of stepping up to the angle as in *P. majori*.

The stronger post-orbital processes in *P. majori* and the absence of the external cingulum in M_1 do not seem in any case to be more than specific.

Brachyprotoma from the Pleistocene of Pennsylvania and Arkansas, in spite of the absence of P^1 and P^2 clearly possesses many primitive characters such as the large size of P^4 and M_1 ; the large size of the anterior premolars; the smaller protocone in P^4 ; the weaker metaconid in M_1 ; the transverse elongation of M^1 . It seems to be a survival of a much more primitive form than any species of *Promephitis*.

The mandibular ramus described by Simionescu (1930, pp. 93, 140) from the Upper Pliocene of Malusteni under the name of *Promephitis malustenensis*, is insufficiently figured and described to enable its affini-

ties to be readily grasped. The ramus is far too long and the premolars too large for it to find a place in the genus *Promephitis*. If mephitine at all, it is probably more nearly allied to *Trocharion* and *Mydaus*.

A solitary specimen of M_1 from the Bohnert of Melchingen was referred by Schlosser (1902, p. 146, Pl. II (VII), figs. 14, 16) to the genus *Promephitis* with the specific designation of *gaudryi*. I have elsewhere (Pilgrim, 1933, p. 859) expressed the opinion that this tooth is probably generically if not specifically identical with *Trocharion albanense* Major (Major, 1903, p. 536). Dr. Helbing, who has examined the specimen, has since been good enough to confirm this.

REMARKS.—Throughout the description of the holotype of *P. majori*, comparisons with each one of the living genera have been made. While it shows features in common now with one and now with another of these, yet in the structure of the carnassial teeth and the upper molar it is certainly more primitive than any of them. In the shortening of the anterior part of the face and jaw, *Promephitis* exhibits a precocious reduction which seems to imply that it stands on a different branch from any of the existing genera and probably left no descendants. *Spilogale*, though approaching it more closely than *Mephitis* and *Conepatus*, is separated by its inflated bulla and weak mastoid process. I have touched on the question of the evolution of the Mephitinae elsewhere (Pilgrim, 1933, pp. 859, 864), and can add nothing more of value. The origin of the three living genera is in doubt. *Brachyprotoma* is certainly not their direct ancestor, and it seems likely that they represent different lineages which emigrated to America from a region still unknown. *Trocharion*, of the Upper Miocene of Europe, and *Mydaus*, now living in Java, seem to approach more nearly my conception of what the primitive mephitine must have been.

REFERENCES

- ALEXEJEW, A. K. 1915. Animaux fossiles du village Novo-Elisavetovka, pp. xiv+453, Pls. I-X. 8vo. Odessa.
- BROWN, BARNUM. 1908. The Conard Fissure, a Pleistocene Bone-deposit in Northern Arkansas. Mem. Amer. Mus. Nat. Hist., IX, pp. 157-208, Pls. XV-XXV.
- GAUDRY, ALBERT. 1862-3. Animaux fossiles et Géologie de l'Attique. Carnivores, pp. 37-120, Pls. VI-XVII. 4to. Paris. (The dates of publication of the various parts of this work are stated in Pilgrim and Hopwood, 'The Pontian Bovidae of Europe'.)
- HOWELL, A. H. 1901. Revision of the Skunks of the genus *Chincha*. U. S. Dept. Agr., Biol. Surv., North American Fauna, No. 20. Pp. 1-47, Pls. I-VIII.
1906. Revision of the Skunks of the genus *Spilogale*. U. S. Dept. Agr., Biol. Surv., North American Fauna, No. 26. Pp. 1-55, Pls. I-X.
- MAJOR, C. J. FORSYTH. 1894. Le gisement ossifère de Mitylini et Catalogue d'ossements fossiles, 51 pp. Small 4to. Lausanne.
1903. New Carnivora from the Middle Miocene of La Grive Saint Alban, Isère, France. Geol. Mag., (4) X, pp. 534-537.
- PILGRIM, G. E. 1931. Catalogue of the Pontian Carnivora of Europe. Brit. Mus. Cat., pp. VI+174, Pls. I, II, 30 text-figs.
1933. The genera *Trochictis*, *Enhydriactis* and *Trocharion*, with remarks on the taxonomy of the Mustelidae. Proc. Zool. Soc. London, 1932, pp. 845-867, Pls. I, II, 2 text-figs.
- POCOCK, R. I. 1921. On the External Characters and Classifications of the Mustelidae. Proc. Zool. Soc. London, 1921, pp. 803-837, 13 text-figs.
- SCHLOSSER, MAX. 1902. Beiträge zur Kenntniss der Säugethierreste aus den süd-deutschen Bohnerzen. Geol. u. Pal. Abh., new ser. F, V, pp. 117-258, Pls. I-V.
1924. Tertiary Vertebrates from Mongolia. Palaeont. Sinica, Ser. C, I, fasc. 1, pp. 1-119, Pls. I-VI, 5 text-figs.
- SIMIONESCU, J. 1930. Les Vertébrés Pliocènes de Malusteni (Roumanie). Publicat. Fondului Vasile Adamachi Acad. Romana, IX, No. 49, pp. 83-151, Pls. I-V, 81 text-figs.

AMERICAN MUSEUM NOVITATES

Number 664

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Sept. 30, 1933

59.57.33 (87)

DRAGONFLIES FROM MT. DUIDA AND THE VENEZUELAN BORDER

BY JAMES G. NEEDHAM

A small collection of pinned dragonflies from the Venezuelan border and adjacent parts of Brazil, sent to me for determination by The American Museum of Natural History, contains some interesting new material. Not all of it is specifically determinable, for some of the specimens are teneral and many are broken. Among the whole ones, however, in condition fit for description, there are specimens representing one new genus and two new species. A list of species by localities follows, with descriptions of the new forms given at its close.

MT. DUIDA

Orthemis ferruginea Fabricius.—A single male, October 27, 1926.

Zenithoptera americana Linnaeus.—One female, March 7, 1929; a male, October 10, 1928.

Erythrodiplax umbrata Linnaeus.—One male, October 27, 1928.

Ephidatia batesii Ris.—One female, October 21, 1928.

Mecistogaster linearis Fabricius.—One male, November 23, 1928.

Dimeragrion secundum, new species.—Two males, December 8, 1928.

Tate No. 433. See p. 5.

Argia (species?).—Undeterminable fragments of apparently three species.

Metaleptobasis (species?).—A single undeterminable female, December 23, 1929. Tate No. 373.

Acanthagrion (species?).—A single fragment of a male, December 10, 1928.

Rima arcana, new genus and species.—See p. 3.

Aeolagrion fulvum, new species.—See p. 5.

MT. RORAIMA

Staurophlebia reticulata Burmeister.—A single female of very large size (hind wing, 75 mm.), January 2, 1928.

Aeschna (species?).—A single female, not certainly determinable; of the *A. cornigera* group.

Nephepeltia (species?).—A single female with the end segments of the abdomen lost, apparently near *N. flavifrons*, yet not agreeing with other species of the genus in certain venational characters; in the possession in the fore wing of a half antenodal cross-vein ($6\frac{1}{2}$ in all), in a subtriangle of two cells, in having two cross-veins behind the stigma, and in having two full cell-rows in the space beyond the triangle. Despite these considerable differences I believe it belongs in *Nephepeltia* because of major agreements in form of triangles, in the origin of vein Cu₁ from the outer side of the triangle in the fore wing, in the general disposition and number of cross-veins, and in having the radial planate subtend and definitely circumscribe four cells in the front wing and three in the hind.

Orthemis ferruginea Fabricius.—One male, Paulo, 4000 feet, December 17, 1927.

Uracis ovipositorix Calvert.—Two females. Aribupu, altitude 4200 feet, December 20, 1927.

Erythrodiplax abjecta Rambur.—One male. Philipp Swamp, altitude 5000 feet, October 28, 1927. One pair, January 28, 1929.

Erythrodiplax attenuata ? Kirby.—Two females.

Sympetrum illotum Hagen.—One male from summit, at 8600 feet, November 24, 1927. Comes nearest the variety *virgula* of De Selys in coloration.

Lais (species?).—Two undeterminable fragments from an altitude of 4200 feet.

Heteragrion ictericum Williamson.—One male from an altitude of 4200 feet, December 26, 1927.

OTHER LOCALITIES

Orthemis ferruginea Fabricius.—One male from Rio Negro Brazil, February 19, 1928.

Erythemis credula Hagen.—One male, September 15, 1928.

Erythrodiplax attenuata Kirby.—Two males, Rio Negro Brazil, September 24, 1928.

Diastatops obscura Fabricius.—One female, Rio Casiquiare, Venezuela, September 30, 1928.

Triacanthagyna septima De Selys.—Two females, Low Amazonas, April 29.

Neoneura (species).—One male (fragment), Rio Negro, Brazil, September 10, 1929.

RIMA, new genus

Head broad, with low occipital ridge and with hardly any frontal prominence. Hind lobe of the prothorax produced (♀) into a thin flat plate. Legs moderate, with spines rather few and short. Claws toothed well before the apex. Wings stalked to near the level of the first antenodal cross-vein. Arculus a little before the second antenodal cross-vein, its upper piece very short, and the space between this and the subnodus without cross-veins. Middle fork much nearer the arculus than the nodus. Quadrangle oblique and sharply pointed, its front side a little shorter in the fore wing and a little longer in the hind wing than the inner side. There are no cross-veins in quadrangle, subquadrangle, or in the space behind the latter. Stigma rather elongate, without brace-vein. Vein M_2 parts from M_1 a little beyond the subnodus. Three rows of intercalary cells occupy the marginal interspaces immediately behind veins M_{1+2} , M_2 , Rs and M_4 .

GENOTYPE.—*Rima arcana*, new species.

This form is so distinct from all other known *Zygoptera* that I have no hesitation in giving it a name. In venation it is nearest to the Indian genus *Megalestes*. It is allied to the Neotropical *Hypolestes*. From both of these it differs in the remoteness of the nodus from the arculus, and in the more proximal origin of veing M_2 . It agrees with *Hypolestes* in lacking a brace-vein to the stigma, but further differs in having intercalaries between veins M_2 and Rs , and a more elongate stigma.

The nymph of *Hypolestes* (if rightly identified) is, however, not lentine at all. More knowledge of the immature stages of these and allied forms is needed to establish their relationship.

The name I have used, it will be observed, is that of the heroine of Wm. H. Hudson's Venezuelan novel, 'Green Mansions.'

Rima arcana, new species

Length, 41; abdomen, 30; hind wing, 30 mm.

Colors dull greenish-black and brown. Head dull black above from antennae to occiput, with a suggestion of a pair of minute pale dots between the antennae. Face yellow, with a smooth, bare and shining greenish-black labrum, and a squarish patch of the same color on the middle of the horizontal upper surface of the post-clypeus. Jaws and labium yellow, heavily tipped with black. Rear of head black. The six segments of the black antennae are of nearly equal length, and all beyond the basal one are very slender.

Prothorax dull yellowish-brown with a black spot covering its projecting hind lobe and a small adjacent crescentic area on the middle lobe. Synthorax brown, with a wide greenish-black middle stripe that at its ends overspreads the outer angles of crest above and collar below in fore-and-aft symmetry. In the brown of the sides there are obscure darker bands in front of and bordering the three lateral sutures. The middle one is darkest, being almost black.

Legs brown basally, becoming black beyond the knees. Tibial spines slightly longer than the intervals between them; fourteen in number in the outside row on the hind tibia.

Wings hyaline with black beins and brown stigma. Postnodal cross-veins 17 to 18, and 15 to 16 in fore and hind wing respectively. There is an extra half antenodal in the costal space of the left hind wing, as shown in figure 1. Stigma 4 mm. long by 1 mm. wide; a little widened between heavy bordering black veins, about equally acute at the ends. Behind it are six or seven cross-veins. Vein M_{1a} approaches M_1 convergently behind the stigma and is followed by three cell-rows thence to the wing

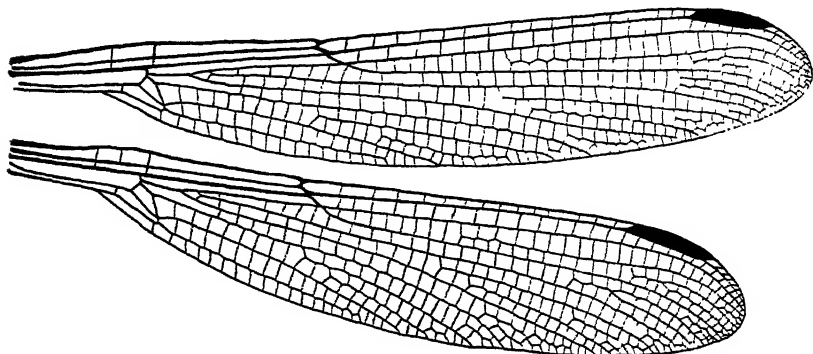


Fig. 1. *Rima arcana*, new species.

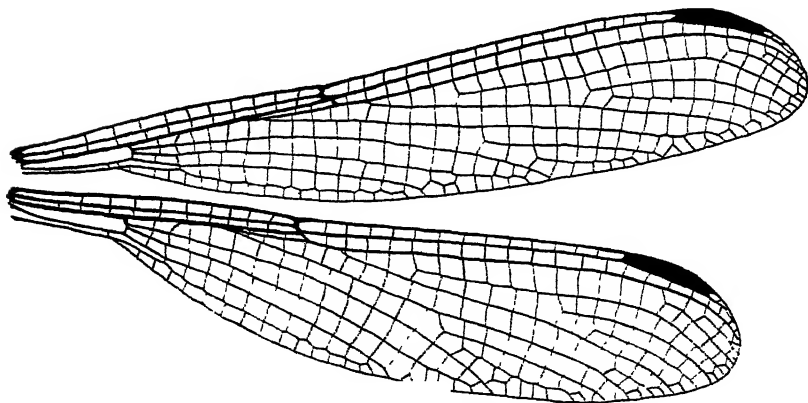


Fig. 2. *Dicerias procera*, Selys

margin. Veins M_3 and M_4 diverge at the wing margin with an irregular disposition of cells between them. Vein Cu_1 springs forward from the apex of the quadrangle, and then for a distance runs parallel with M_4 . Behind veins Cu_1 and Cu_2 are single rows of cells.

Abdomen greenish black above, dull yellowish-brown beneath from end to end. The paler color rises a little higher on the sides of the basal segments. There is a wash of blackish on both base and tip of the ovipositor. The tenth abdominal segment is

divided to the base by a deep mid-dorsal cleft. Cerci hardly as long as the tenth segment, thick and subtriangular. The ovipositor slightly surpasses the tip of the hairy anal tubercle. Its slender declined tips are about as long as the cerci. Its lower margin is smooth at base but very finely denticulate toward the tip.

There is a single female specimen from Mt. Duida, Venezuela; January 4, 1929. Amer. Mus. accession No. 29500; Tate No. 527.

With the figure of the wing of *Rima*, we present a drawing of *Dicterias* (from the same region)—the only American agrionine genus of which the venation has not hitherto been adequately figured.

Dimeragrion secundum, new species

Length, 52; abdomen, 44; hind wing, 31 mm.

This is a greenish-black, yellow-faced species with very long and slender abdomen. Top of head black, this color extending forward in a stout-stemmed T-spot whose slender top-bar lies on the frontoclypeal suture.

Prothorax yellowish, black-barred across the front margin and more narrowly across the thinly fringed rear margin. Synthorax greenish black with a translucent brownish-yellow stripe before the humeral suture. Sides brownish yellow with a diffuse streak of greenish black just behind the humeral suture and a narrow black line along the subalar carina; below, yellow. Legs blackish beyond the yellow basal segments. There are six long spines and two close-set shorter ones in the outer row on the hind tibia. Wings hyaline. Postnodal cross-veins 25 and 24 in fore and hind wing respectively. There is no cross-vein in the space before the anal crossing. Otherwise, very closely similar to *D. percutitale* as figured by Calvert, 1913, Proc. Acad. Nat. Sci. Phila., Plate xiv, figure 6, except that the veins M₂ and R_s arise a little farther forward; R_s very close to the subnodus, and M₂ nearly a full cell-length before it.

Abdomen blackish above and yellowish at the sides and beneath. The brown is dilated into an apical ring-band on segments 3 to 7 and there is a narrower, brighter yellow basal ring on the same segments. Segments 8 to 10 are more extensively dark brown or blackish, the apex of 10 being wholly black. There is a black (-mark on the hind margin of segment 1 at the side, and there are two similar but smaller (-marks on the rear of the metathorax just before it. Superior appendages black, paler within; inferiors brown. These are similar to those of *D. percutitale* as figured by Calvert (*loc. cit.*, Figs. 7 and 8), except that the superiors are distinctly longer than the inferiors, and the plate that they bear internally is very much broader and projects obliquely downward and forward in a blunt barb-like angulated recurrent lobe.

The single specimen is a fairly mature male from Mt. Duida, Venezuela; December 16, 1928. Amer. Mus. accession No. 29500.

This is a larger species than *D. percutitale*, differing in many minor points of coloration.

Aeolagrion fulvum, new species

Length, 42; abdomen, 35; hind wing, 22 mm.

This is a brownish-rufescent species having the thorax heavily striped with black. Face rufescent up to and including the antennae. Top of head black with a

pair of small pale V-marks which may be enlarged and united at the middle ocellus into a transverse yellow W-mark. The hind margin of the occiput is obscurely paler.

Prothorax tawny, with three black blotches, a median one on the base of the hind lobe and two lateral ones on the sides of the middle lobe. There are also some black dots above the coxa. Synthorax with a broad and regular black mid-dorsal stripe that is wider than the bordering pale stripe. A fine line of brown in the depths of the humeral suture is expanded into an oval spot near its upper end. A broad black stripe covers most of the mesepimeron, its front edge straight, its hind margin serrately notched into three big decurrent teeth. The upper end of the third lateral suture, points on the subalar crest, and the lower hind angle of the metepimeron are narrowly touched with black. The remainder of the sides and all of the venter are tawny yellow.

Legs uniformly reddish, with black spines and claws. Hind tibiae with seven spines on each row, longest in the middle, the two proximal spines weaker than the others.

Wings slightly yellowish in tint, with brown veins and tawny stigma. Postnodal cross-veins about 14 and 13 mm. in fore wing and hind wing respectively.

Abdomen pale reddish-fulvous, a little darker at the ends, without pattern. The dorsal apical margin of the tenth segment is uprolled and erected in a thickened rim that is bilobed, pale on its anterior and blackish on its posterior face. Superior appendages of the male as long as tenth segment. Viewed from above they are at first subcylindric, then obliquely truncated to their divergent tips, and blackened on the face of the truncated surface. Viewed from the side their thick ascending basal third bears above an obtuse tubercle, after which they are suddenly narrowed, flattened and then tapered to a blunt black tip. The inferior appendage viewed from the side is slightly shorter than the superior, thick at the pyramidal base, then directed straight to rearward and tapered to the black tip, which bears a low superior tooth. Viewed from beneath, beyond the stout approximated bases of the inferior pair, the tapering blunt-ended tips form a (-) shaped enclosure.

The single headless female in the collection shows the same pattern as the male, with more darkening on the dorsum of the prothorax and along the dorsum of the abdomen as far as the apex of the ninth segment. The black stripes of the synthorax are wider, but otherwise similar.

In both sexes there is a thin fringe of long tawny hairs on the dorsum of the thorax and on the venter of the basal abdominal segments.

Twelve males and one female; Mt. Duida, Venezuela; January 7, 1929. Amer. Mus. accession No. 29500; Tate No. 539.

This species belongs to the group having the superior appendage of the male unbranched. It is allied to *A. demerarum* Williamson, but is readily distinguished in the male by the all-red abdomen, by the uprolled and erected apex of the tenth abdominal segment, and by the form of the appendages.

AMERICAN MUSEUM NOVITATES

Number 665

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Oct. 5, 1933

59.88,1 N (9)

BIRDS COLLECTED DURING THE WHITNEY SOUTH SEA EXPEDITION. XXVI¹

NOTES ON *NEOLALAGE BANKSIANA* (GRAY)

BY ERNST MAYR

A study of *Neolalage banksiana* (Gray), undertaken as a continuation in the series of revisions of Polynesian genera of birds, has resulted not only in clearing up some doubtful points concerning the taxonomic position of this species, its geographical variation and distribution, but also has led to an investigation of certain variations of plumages and to a discussion of the physiology of feathers. In consideration of the divergence between the taxonomic investigation and the study of the physiology of feathers, I have decided to devote a separate paper to the latter subject. I am indebted to Mr. John T. Zimmer for much valuable assistance in the study of this genus.

NEOLALAGE Mathews

Neolalage MATHEWS, 1928 (Oct. 30), Bull. Brit. Orn. Club, XLIX, p. 19, new name for

Pseudolalage MATHEWS, 1928 (July 31), Nov. Zool., XXXIV, p. 372 (*nec* Blyth, 1861). Type (by original designation): *Lalage banksiana* Gray.

GENERIC CHARACTERS.—Bill (from forehead) almost as long as head, narrow and laterally compressed, but slightly depressed at base; higher than wide at the nostrils; culmen ridged and somewhat curved, lower mandible near tip also ridged; tip of maxilla strongly uncinate with a subterminal notch; nostril circular, not operculate, exposed or just slightly covered with short, weak bristles; feathering of forehead covering the base of the bill and reaching the posterior margin of the nostrils; length of the whole bill (from base) slightly shorter than tarsus; rictal bristles well developed, but not very strong; tarsus scutellate, scutellae large; length of tarsus slightly more than one-fourth of wing; wing moderately pointed; first primary relatively long, longer than half of second; fifth primary longest, or fourth and fifth subequal; usual wing formula $5 > 4 > 6 > 3 > 7 > 8 > 9 > 10 > 2$; tail-feathers twelve; tail distinctly rounded, the lateral tail-feathers being shorter than the central ones; length of tail about four-fifths of wing; plumage compact, feathers of forehead and lores short and stiff; sexual dimorphism very slight, almost unnoticeable, except for the average smaller size of the females; juvenal plumage not spotted.

¹Previous papers in this series comprise American Museum Novitates, Nos. 115, 124, 149, 322, 337, 350, 356, 364, 365, 370, 419, 469, 486, 488, 489, 502, 504, 516, 520, 522, 531, 590, 609, 628, and 651.

Neolalage banksiana was originally described as a species of *Lalage*. The shape of the bill and the color pattern suggest this classification, but on the other hand, as Ramsay says with good reason, this bird is not at all a *Lalage*. A close study of the species led me to the conclusion that Ramsay was not far off in considering it a species of the genus *Monarcha* (*Piezorhynchus*). However as close as *banksiana* may be to the other species of *Monarcha*, the bill is not that of a *Monarcha*. It is a narrow bill, higher than broad on the base. I realize that the shape of the bill is not of such a high generic value as it is usually considered, but the separation of *banksiana* from *Monarcha* is supported by several other characters as described above. In many aspects the bird resembles *Pomareopsis brujni* from New Guinea. Considering all the evidence, it appears to be justified to found on *banksiana* a distinct genus which was named *Neolalage* by Mathews in complete ignorance of the real relationship.

***Neolalage banksiana* (Gray)**

Lalage Banksiana G. R. GRAY, 1870 (May), Ann. Mag. Nat. Hist., (4) V, p. 329, Vanua Lava, Banks Islands.

Piezorhynchus sericeus RAMSAY, 1888 (or ? 1889), Proc. Linn. Soc. N. S. W., XIII (2 Ser., Vol. III), p. 1293, Espiritu Santo, New Hebrides.

Lalage flavotincta SHARPE, 1899 (Dec. 30), Bull. Brit. Orn. Club, X, p. 28 (cf. Ibis, 1900, p. 342, 364), Espiritu Santo, New Hebrides.

ADULT MALE.—Lores, sides of head, sides of neck, chin, and upper throat white; forehead, crown, hind neck, scapulars, and back black with a slight bluish gloss; narrow band across the lower throat black; breast, abdomen, and under tail-coverts buffy white, in very fresh plumage deep orange buff; primaries and primary-coverts black, upper wing-coverts, tertials, and innermost secondaries more or less white; under wing-coverts, axillaries and inner edges of wing-feathers buffy white; lower rump and upper tail-coverts buffy white (with a few blackish feathers mixed in); central pair of tail-feathers black with small triangular shaped white tip; amount of white on the tail-feathers increasing until the outermost tail-feather is almost entirely white with the black reduced to the lower two-thirds of the outer web and a small area on the inner web.

Iris brown, bill black, feet dark gray.

ADULT FEMALE.—Very similar to adult male, but smaller; whitish feathers on throat shorter and with broader grayish bases, particularly near the chin; black of upperside frequently duller; white areas on wing reduced; black spot on seventh secondary much larger, in some cases even the eighth secondary with an extended black spot along the shaft.

IMMATURE (typical).¹—Somewhat similar to adult, but all colors less pure and less intense. Crown dark gray, back grayish olive-brown; white on throat and sides of head less pure, gray bases of the feathers more pronounced; band across lower

¹For further details see American Museum Novitates, No. 666.

throat grayish; breast, abdomen and under tail-coverts deep buff; wing-feathers brown, primaries with clay-colored, secondaries with buffy edges; median and greater upper wing-coverts, with buffy white tips; tail-feathers brown, buffy white tips much reduced in size as compared with adult; bill yellowish.

NESTLING.—The collection contains no specimen in the actual nestling plumage, but several that are molting from the nestling to the first year plumage. From these we can reconstruct the nestling plumage as follows: entire body covered by soft downy feathers which are white on breast and abdomen, and cinnamon to rufous on the upper parts; primary-coverts, greater upper wing-coverts, wing-feathers and tail-feathers are the first feathers of the first year plumage to be acquired.

		WING	TAIL
Efate	7 ♂ ad.	76-81 (79.3)	61-63 (61.8)
Epi	3 ♂ ad.	79-80 (79.3)	63-65 (64.3)
Santo	12 ♂ ad.	74-80 (77.2)	59-65 (62.6)
Vanua Lava	4 ♂ ad.	75-78 (76.2)	58-62 (60.2)
Efate	7 ♀ ad.	73-78 (75.1)	57-64 (59.9)
Epi	3 ♀ ad.	74-78 (76.0)	62-63 (62.7)
Santo	1 ♀ ad.	78	
Vanua Lava	3 ♀ ad.	70-76 (73.3)	57-61 (58.7)

RANGE.—New Hebrides (Efate, Epi, Ambrym, Aurora, Pentecost, Aoba, Malekula, Malo and Santo) and Banks Islands (Vanua Lava).

Specimens were collected between June 1926 and January 1927. Plumage condition, size of gonads, and the study of the immature birds provide sufficient evidence for the statement that the whole life cycle in this species is about one month later than in *Myiagra vanikorensis* of Fiji (see Amer. Mus. Novit., No. 651, pp. 12-14).

FADING IN *Neolalage*

This species is very apt to fade (especially in its orange-buff colors) not only during the progress of the season, but also in the museum collections.

Specimens collected from June to August have a rich orange-buff on breast and abdomen, specimens from November are much paler, and those collected in January are almost whitish underneath. This is well demonstrated by the material of the Whitney South Sea Expedition, which was collected during one year (June 1926-January 1927). On the other hand the material of the British Museum (examined in 1932) reveals that the process of fading goes on even in dark museum cabinets. The types of *banksiana* (collected on Vanua Lava in 1865) are now almost whitish underneath, the types of Sharpe's *flavocincta* (collected on Santo and Malekula in 1899) are very pale yellowish buff, while three new skins (collected on Santo in 1927 by Baker) are rich orange-buff.

The possibility of fading was considered neither by Ramsay nor by Sharpe when, independently, they separated the Santo birds from typical Banks Islands birds, with the following curious result. Ramsay, who evidently had a very faded specimen, says that his Santo specimen differs from *banksiana* by being pure white underneath and not buffy white, while Sharpe on the contrary, having fresh birds (June–August) from Santo, separates them from *banksiana* as being “of a beautiful yellow instead of white” (Ibis, 1900, p. 342) underneath. However, he is greatly puzzled by the fact that Efate birds are as whitish as Banks Islands specimens, which does not fit with the geographical distribution.

The realization of the fading of the buffy colors in this species clears up all these difficulties.

GEOGRAPHICAL VARIATION IN *Neolalage*

We find in *Neolalage banksiana*, just as in many other species of island birds, a slight geographical variation, which can not be expressed in taxonomic terms. However, it may be interesting and useful to point out the slight differences existing between birds from various islands of the range. Sharpe separated the Santo bird from the Vanua Lava birds as being more yellowish, but this is not true, as I have just pointed out. Ramsay lists a series of differences, but not one holds true. He says that his *sericea* from Santo differs from *banksiana* “in having black bases to the upper tail-coverts [so does *banksiana*!], in having no distinct eyebrow [not true!], in having the white of the throat extending round the hindneck [not true!], the narrow pectoral band joining the interscapular region [also in *banksiana*].” However, the birds from Malekula, Malo and Santo undoubtedly have the white marks on wing and tail larger than those of the birds from the other islands, a fact which is demonstrated in the following table:

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>
Aurora	2	10, 13 (11.5)	4, 5 (4.5)	100	0
Efate	7	13–16 (14.3)	7–12 (8.4)	100	0
Pentecost	2	13, 15 (14.0)	7, 11 (9.0)	100	0
Aoba	4	15–17 (15.7)	8–11 (9.2)	50	0
Epi	3	14, 19 (16.5)	9–11 (10.0)	66½	0
Vanua Lava	4	16–18 (17.5)	8–10 (8.5)	25	0
Malekula	12	13–20 (16.5)	12–17 (13.7)	75	42
Santo	9	14–21 (16.3)	15–22 (17.7)	33½	20
Malo	5	14–23 (18.8)	17–23 (20.0)	60	20

a = Locality

b = Number of adult males examined

c = Extension of white along the shaft on the outer web of the outermost tail-feather; measured in millimeters

d = Extension of white along the shaft on the inner web of the central tail-feather; measured in millimeters

e = Percentage of specimens showing the presence of black on the seventh secondary

f = Percentage of specimens showing the presence of white on the alula

This table shows that the amount of white in wing and tail is lowest in birds from Aurora, and highest in those from Malo, but that there is a gradual intergradation between them. Birds from Malekula, Malo, and Santo have somewhat more white than birds from all the other islands, but it seems inadvisable to separate them subspecifically on such a slight character, particularly as these three islands are right in the middle of the New Hebrides chain.

Going from the north (Vanua Lava) toward the south (Epi and Efate) there is a slight increase in size (see table, p. 3), but there is a great deal of overlapping.

AMERICAN MUSEUM NOVITATES

Number 666

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Oct. 7, 1933

59.82:14.78, 7

BIRDS COLLECTED DURING THE WHITNEY SOUTH SEA EXPEDITION. XXVII¹

NOTES ON THE VARIATION OF IMMATURE AND ADULT PLUMAGES IN BIRDS AND A PHYSIOLOGICAL EXPLANATION OF ABNORMAL PLUMAGES

BY ERNST MAYR

A study of the immature plumages of *Neolalage banksiana* (Gray) has brought out some interesting facts concerning the physiology of feathers and has led to an investigation of some problems concerning the variation of plumages of birds with age. The results of a study of skins have been compared with the recent advances in the field of experimental physiology, and an attempt has been made to explain the physiological causes of certain abnormal plumages, which thus far have been very puzzling to the ornithologist. I am indebted to Dr. G. Kingsley Noble for a helpful discussion of the problems of the physiology of the bird feather.

HISTORICAL REVIEW AND SUMMARY OF OUR PRESENT KNOWLEDGE ON ABNORMAL IMMATURE AND ADULT PLUMAGES OF BIRDS

In the preceding paper,² I described the normal immature plumage of *Neolalage banksiana* (Gray). This plumage vaguely resembles the adult plumage, but the parts of the plumage that are blackish in adult birds are grayish or brownish, all other colors are less intense, and the whitish patterns less pure. This seems to be the more primitive type of immature plumage. However, quite a number of specimens wear a different immature plumage which approaches in its coloration the adult plumage.

This seems to be another case of what is termed in the recent ornithological literature as "retarded" and "progressive" plumages. The presence of two immature plumages suggests of course immediately two further possibilities: one is that there is a fourth plumage (a prenuptial plumage) inserted between the immature and the adult plumage, and the other that the birds described as having a "progressive" first-year plumage are molting the body plumage from the first-year (=immature)

¹Previous papers in this series comprise American Museum Novitates, Nos. 115, 124, 149, 322, 337, 350, 356, 364, 365, 370, 419, 469, 486, 488, 489, 502, 504, 516, 520, 522, 531, 590, 609, 628, 651, and 665.

²American Museum Novitates, No. 665, pp. 1-5.

plumage to the adult plumage. A careful study of more than twenty-five birds in the first-year plumage (including several molting specimens) convinced me that neither of these two alternative possibilities can be accepted. Furthermore, the case that a bird has two types of first-year plumage (a progressive and a retarded one) is not unusual.

So far as I know these plumages for the first time were correctly identified in the Black Redstart (*Phoenicurus ochrurus gibraltariensis* (Gmelin)) of Europe. Kleinschmidt (Berajah, *Erithacus Domesticus*, pp. 9-12, 1907-1908) gave a fairly clear picture of the various plumages although he did not realize all the complications. In this species two juvenal plumages are now known: one grayish one, similar to the female plumage (*cairei*-plumage, Gerbe), and one blackish one, similar to the fully adult male (*paradoxus*-plumage, C. L. Brehm). It was also known that even in the adult plumage of the male a grayish phase is possible, a fact not appreciated by Kleinschmidt. This author however pointed out that there is a possible geographical variation in the proportional frequency of the two juvenal plumages. He found relatively many more "*paradoxus*" juveniles in his material from Spain and Asia than among his central European birds, but left open the question as to whether or not this was merely accidental.

Stresemann, in his monograph of the Macedonian bird fauna¹ added considerably to the elucidation of the problem. He coined the term "Fortschrittskleid," for what I call in this paper "progressive plumage," and "Hemmungskleid," for what I call "retarded plumage." He also called attention to the fact that this divergence of first-year plumages is not peculiar to the species *Phoenicurus ochrurus*, but recorded it for four other species (*Muscicapa hypoleuca*, *op. cit.*, p. 119; *Muscicapa albicollis*, *op. cit.*, p. 121; *Sylvia atricapilla*, *op. cit.*, p. 138; and *Sylvia communis*, *op. cit.*, p. 141). Further facts brought out in this stimulating work are that such plumages may also occur in adult birds: namely, "retarded" plumages in adult males (*op. cit.*, p. 176) and "progressive" plumages in adult females (*op. cit.*, p. 174).

Obviously such plumages occur in many species of birds (as for example in the American redstart and the orchard oriole), but it is not my task here to collect all such cases, particularly since the significance of those plumages was usually not recognized by the authors describing them. It would make it necessary to examine their material again. I will therefore cite only a few more instances in which these plumages were definitely termed "progressive" and "retarded."

¹1920, 'Avifauna Macedonica,' München, p. xvi.

There is a detailed paper on the snow bunting (*Plectrophenax nivalis*), by Natorp,¹ in which the author emphasized the fact—already mentioned by Stresemann—that the divergence of plumages is not restricted to the first-year dress but can also occur in the adult male, and even in the female plumage. He found some atypical females that showed a distinct approach toward the male plumage, without being actually cockfeathered.

These two plumages, however, are not always sharply defined; many specimens are somewhat intermediate, a fact first brought out by Kleinschmidt in his paper on the black redstart, and also mentioned by Natorp.

In the course of my revisions of Polynesian genera I have come across several cases of such dimorphic plumages. It may be worth while to recapitulate my previous findings.

I first noticed the two phases of juvenal plumage in the genus *Erythrura* (Amer. Mus. Novit., No. 489, p. 8), but insufficient material prevented me from discussing the details. However, it is clear that at least in the species *Erythrura cyanovirens* there are two immature plumages, one being typical and the other showing an approach toward the adult male.

A doubtful case is presented by *Ptilinopus solomonensis ambiguus* Mayr (Amer. Mus. Novit., No. 504, p. 7). We have here several specimens resembling very much the adult birds, but approaching in certain minor characters the juvenal plumage. These birds may wear a "first-year plumage," but since such a plumage is unknown from any other pigeon, they may also be adult birds in a "retarded" plumage. A tendency toward a "progressive" juvenal plumage occurs in the genus *Myzomela*, but the phenomenon does not seem to be universal in this genus (Amer. Mus. Novit., No. 516, p. 18).

The genus *Pachycephala* is the first one encountered by me, where "progressive" and "retarded" plumages are quite common. But since the usual juvenal characters are not well defined in all the subspecies, it is sometimes difficult to decide whether a certain specimen is a juvenal bird in a "progressive" plumage, or an adult bird in a "retarded" plumage. Size of testes and shape of wing and tail indicate that most of these birds are in a "retarded" adult plumage (Amer. Mus. Novit., No. 522, pp. 2, 11, 13, 14, 16–21; No. 531, pp. 4, 13, 15, 21). It is interesting to note that such unusual plumages are quite frequent in some of the subspecies, but entirely lacking in others in spite of the considerable material available.

¹1931, Journ. f. Ornith., pp. 338–346.

Adult males in a "retarded" plumage and adult females with a "progressive" plumage are also found in the species *Clytorhynchus nigrogularis* Layard (Amer. Mus. Novit., No. 628, p. 17) and in the genus *Myiagra* (Amer. Mus. Novit., No. 651, p. 6).

Familiarity with all these cases of abnormal plumages makes it easier to understand the plumages of *Neolalage* in which genus, however, conditions are not so clear as in most of the cases just mentioned. There are many complicating features and the material at hand is not sufficient to clear up all of the doubtful points. The best way of presenting my findings seems to be to discuss in detail the plumages of the not typically adult specimens and summarize afterwards the probable interpretation of the data.

DETAILED DESCRIPTION OF IMMATURE SPECIMENS OF *Neolalage banksiana* (GRAY)

EFATE ISLAND

Nos. 212865 and 212866.—Immature females, ovaries "small," June 1926.

Both birds are in the typical female immature or first-year dress. No remains of the downy nestling plumage can be found, nor any approach toward the adult plumage (description Amer. Mus. Novit., No. 665, p. 2).

No. 212862.—An immature female with "small" gonads, June 1926.

The bird has an essentially typical first-year plumage. The crown however is slightly darker than in the two birds just described, the collar on the throat is slightly darker, with a few feathers adorned with blackish tips, the scapulars with a few blackish feathers and practically all the upper tail-coverts with black bases. These blackish feathers belong unquestionably to the same generation of feathers as the other immature feathers and cause me to classify the specimen as an intermediate progressive plumage.

Nos. 212860 and 212861.—Two immature males with "small" testes, July 1926.

Both birds represent the typical first-year plumage of the male of this species. This plumage is very similar to the equivalent female plumage, but it differs in a few minor points. The relative wideness of the breast-band and its much more blackish coloration are conspicuous.

No. 212857.—Immature male, size of testes "minute," June 1926.

This bird wears a puzzling plumage. The bill is yellow brown and the wing (with the exception of the lesser upper wing-coverts) as in typical immature birds. However, the underside resembles very much that of the adult bird, although the white feathers of the throat are not quite so long and the black breast-band not so deeply black; the tail-feathers are brownish and immature looking at the tip, but get more and more blackish toward the base; the upperside (crown, back, scapulars, rump, and upper tail-coverts) are a mixture of immature and adult-like feathers. Most of

the latter lack the deep glossy-black appearance of a back feather of the adult bird. They are dull black frequently with a brownish-black tip. In between these feathers are some that are more brownish, and some that are grayish brown, similar to the feathers of a typical immature male; the lesser upper wing-coverts are blackish, and the median wing-coverts with broad pure white tips. Some of the characters of this bird strongly suggest a molting condition, particularly the diversified character of the plumage. Against this there are several arguments: first, June (when the specimen was collected) is not the molting season; secondly, I could find no feathers in sheets; and thirdly, even those feathers that approach the adult plumage are not so deeply or brightly colored as typical adult feathers.

EPI ISLAND

No. 216082.—Immature female, ovaries "small," December 1926.

This bird is very similar to No. 212857 from Efate, but in accordance with the season much more worn. One of the tail-feathers is being replaced by an adult one. Otherwise there are no signs of molting. The bill is blackish, not yellowish brown.

PENTECOST ISLAND

No. 216084.—Molting male, testes "swelling?," January 1927.

This bird molts from a progressive first-year plumage (as revealed by the color of the tail-feathers) into a normal adult male plumage.

AURORA ISLAND

No. 217940.—Molting male, testes "large," January 1927.

This bird again is very puzzling. It seems to have just begun to molt from a "progressive" first-year plumage into the next plumage. But most of the new feathers, appearing in the wing and hind neck, are dull blackish, not vividly black as fresh adult feathers usually are.

No. 217942.—Molting female, ovaries "small," January 1927.

This bird is molting from a progressive immature plumage into an apparently normal adult plumage. A good part of the body plumage of the upperside has been changed already, as have some of the tail- and wing-feathers. Most of the feathers of the underside, however, seem to belong to the first-year plumage. The breast-band is broad and dull black. The bill is blackish.

VANUA LAVA ISLAND

No. 216073.—Immature female, ovaries "small," November 1926.

This bird is very similar to No. 212857 from Efate, except that crown, back, and breast-band are duller black and the upper throat not as pure white. The bill is dusky brown.

AOBA ISLAND

No. 217947.—"Young" male (= testes small), January 1927.

This bird is in the typical immature plumage, similar to Nos. 212860 and 212861 from Efate. The specimen is apparently in fairly fresh plumage and shows neither any signs of molting nor any approach toward the adult plumage. The bill is blackish, instead of yellowish as in most immature birds.

No. 217944.—Molting male, testes "small," January 1927.

This bird is in the middle of the molt from a typical immature plumage to the normal adult plumage. The replacement has already taken place on head, throat, upper back, and part of the rump; new feathers are molting in on all other parts of the body; wing and tail are in the middle of the molt.

SANTO ISLAND

No. 214189.—Immature (II) male, testes "small," September 1926.

This bird wears a typical "progressive" plumage. The black on the upperside is somewhat dull and some of the feathers have brownish edges. Wing- and tail-feathers are typical for these progressive plumages. They are immature near the tip and assume more and more adult characters toward the base. Bill black.

No. 214190 and 214191.—Immature (II) male, testes "small," August 1926.

Both birds very similar to No. 214189, but the bill more or less yellowish.

No. 216077.—Immature (II) male, testes "large," December 1926.

This bird is in the same plumage as the three birds just described although the testes are indicated as large. The bill is yellow and the skull not yet ossified.

No. 216079.—Immature (II) male, testes "small," December 1926.

This specimen is particularly interesting since it proves conclusively that the progressive immature plumage follows immediately the nestling plumage. There are still quite a number of the downy nestling feathers, particularly on the sides of the throat, in the middle of the abdomen and on the upper tail-coverts. The immature plumage is of a very progressive type with the tail, for example, almost indistinguishable from an adult tail.

No. 214196.—Immature (II) female, ovary "small," September 1926.

A typical immature bird in progressive plumage. Several feathers on the back either brownish or with brown edges. Bill black.

No. 214198.—Immature (II) female, ovary "small," August 1926.

Similar to preceding, but bill yellow at base. Skull not ossified. This bird has a body-plumage colored as richly as an adult bird. Wings and tail are also of a very progressive type. In this, as in all those birds with a progressive plumage, the lesser upper wing-coverts as well as some other upper wing-coverts are very similar to the equivalent adult feathers. I could find no evidence that these feathers were not acquired immediately after the nestling plumage, but certain specimens point to the possibility of a prenuptial partial molt in this part of the body. It is still a doubtful point and needs further investigation based on better material.

Nos. 214197 and 214199.—Immature (II) females, ovaries "small," August 1926.

Both birds wear a progressive plumage, but not so pronounced as the two preceding specimens, all the black tones being distinctly duller and with a brownish admixture. Bills brownish.

No. 214195.—Sex indetermined [? ♀], immature, September 1926.

This specimen is particularly interesting since it molts from the nestling to a progressive immature first-year plumage. Soft, downy nestling feathers are retained in the middle of the abdomen, on the under tail-coverts, on the upper tail-coverts, and a few feathers on the scapulars and on the upper back; the rest of the plumage is made up of feathers of the first-year plumage of a rather pronounced progressive type. This specimen also shows that the lesser upper wing-coverts do not belong to the nestling plumage but are molting in with the rest of the first-year body-plumage, while the greater upper wing-coverts and the primary coverts are acquired together with the wing in the nestling plumage. The bill is black with a yellow base.

MALEKULA ISLAND

Nos. 213730, 213731, 213740.—Three immature males, testes "small," August 1926.

All three birds wear a "progressive" first-year plumage. Head and back rather blackish, with relatively few feathers with brownish edges. Bills yellowish brown.

No. 213738.—Immature male, testes "small," August 1926.

This bird really resembles the female in a progressive first-year plumage much more than it resembles the male. However, the large measurements prove the correctness of the sex indication on the label. The bird has crown and back dark grayish with paler or brownish edges; bill yellowish brown.

Nos. 213744, 213745, 214200.—Three immature females, ovaries "small," August 1926.

These three birds are in an intermediate plumage, not quite so blackish and "progressive" as most immature males; most feathers of crown and back with grayish or brownish edges; wings immature, tail immature on tips, blacker toward the base; no signs of molting; bills yellowish brown.

SUMMARY

Summarizing the results of the investigation of these plumages I can state the following facts:

1.—The first-year plumage of *Neolalage banksiana* (Gray) shows two types of plumage: one, apparently more primitive, with a less intense pigmentation, which may be called a "retarded" plumage; and the other, approaching in pigmentation the adult dress, which may be called a "progressive" plumage.

2.—There is no clear-cut division between these two plumages; several specimens are intermediate in their characters.

3.—There is a definite geographical correlation between the frequency of the two plumages on the various islands. On certain islands (as Efate and Aoba) all, or the majority, of the first-year birds wear a "retarded" plumage; on other islands (as Santo and Malekula) all, or the majority, of the first-year birds wear a "progressive" plumage.

4.—The sexual dimorphism is frequently more pronounced in the first-year plumage than in the adult dress. Adult males and females are very much alike in this species, but the first-year plumage of the male is usually much more "progressive" than that of the female.

5.—The "progressiveness" of an individual feather depends a great deal upon the time of its molt. Those feathers of the first-year plumage that grow first, as the wing-feathers and certain of the wing-coverts, resemble the adult feathers least. In some cases, feathers with a much more immature appearance (having grown earlier) can be found adjoining feathers with decidedly more adult characters.

6.—The changing of the physiological status toward the adult condition can be observed in many individual feathers (particularly the tail-feathers). The tip of such a feather greatly resembles an equivalent typical immature feather, while the base is more like that of an adult feather.

7.—Progressive feathers of the first-year plumage resemble adult feathers not only in pigmentation but frequently also in structure. This makes it quite difficult in extreme cases to decide whether a certain specimen is a first-year bird in "progressive" plumage or an adult bird in "retarded" plumage.

PHYSIOLOGY OF IMMATURE AND ADULT FEATHERS

When I first encountered these abnormal plumages I thought that they reflected the development of the gonads during the time of the molt. The same opinion is expressed by Alden H. Miller in his study on progressive first-year plumages in *Phainopepla nitens*.¹ He says (p. 435): "The second variable, that of pigmentation, must be associated with the gonads and probably is the result of a varying degree of development of the hormone-secreting tissues of the testis at the time of molt."

However, there are two serious objections to this. The first one is that the condition of the gonads as indicated by the collectors on the labels of these birds do not agree with Miller's suggestion. Quite frequently we find specimens that, according to their plumage condition, must have left the nest but a few days or weeks and were molting from the downy nestling plumage to a progressive first-year plumage. These birds have minutely small testes and would not have shown any development of their gonads for the next six or eight months.

On the other hand there are the birds that breed in a retarded plumage and molt into this retarded plumage with the gonads decidedly more

¹1933, University of California Publ. in Zool., XXXVIII, No. 13, pp. 425-446.

developed than those birds that molt from the nestling plumage into a progressive first-year plumage.

The other reason for my conviction that the type of plumage that is acquired through the postnatal and prenuptial molt is largely independent of the gonad hormones is based on a study of the experimental data. This I shall illustrate by the following few examples, without attempting to review the entire extensive subject.

There are many complications in the various genera and orders of birds, but the case of the domestic fowl enables us to explain most of the phenomena of plumages. Taking a normal race of fowl we have the following sequence of plumage.

- I.—Downy chick
- II.—Juvenal plumage, male and female similar
- III.—Adult plumage, strong sexual dimorphism

Adult roosters as well as adult hens acquire at the next molt after castration a "Neutral Plumage," which is practically the same for both sexes and greatly resembles the plumage of the adult male. It may be emphasized that the removal of the gonads does not cause the acquisition of an immature type of plumage at the next molt. Equally, if a newly hatched chick of either sex is castrated, its plumage does not retain an immature appearance all through life, but at subsequent molts it acquires first a more or less normal juvenal plumage¹ and then a "Neutral Plumage." This "Neutral Plumage" is alike in both sexes in practically all the cases that have been investigated, but in the house sparrow (*Passer domesticus* Linnaeus) the "Neutral Plumage" is dimorphic and sex-limited.² This simple scheme is slightly complicated in those cases in which there are two molts during the year and accordingly two different adult plumages, one nuptial and one internuptial plumage.

In the case of the European black-headed gull (*Larus ridibundus* Linnaeus) it has been proved by van Oordt and Junge³ that the nuptial plumage (alike in male and female) is no longer acquired after castration and that the "Neutral Plumage" is apparently identical with the internuptial or winter plumage.

The independence of the plumages from the testis hormone is still more pronounced in *Anas platyrhynchos*. Castration of the drake does not prevent a molt into the hen-feathered eclipse plumage.⁴ As may be ascertained by experimental plucking of feathers the plumage cycle is

¹Zawadowski, M., 1926, *Biologia Generalis*, II, pp. 631-638, Pl., XXXI-XL.

²Keck, Warren N., 1932, 'Control of the Sex Characters in the English Sparrow, *Passer domesticus* (Linnaeus)', *Anat. Rec.*, LIV, Suppl., p. 77.

³Van Oordt, G. J., and Junge, G. C. A., 1933, *Roux's Archiv*, CXXVIII, pp. 166-180.

⁴Kuhn, O., *Roux's Archiv*, CXXVII, pp. 519-535.

definitely fixed. There is a latent tendency from the middle of July to April to develop nuptial feathers and from May to the middle of July to develop eclipse feathers. In other words, the bird can acquire nuptial feathers only during a fixed part of the year during which the testes may be in a resting, in a developing, or in a fully developed condition, and similarly the bird can grow eclipse plumage feathers only during a fixed part of the year, no matter whether the gonads are active during this period or absent (as in the castration experiment).

All these observations and experiments allow the following interpretation: one of the phenomena of reaching maturity in birds is a gradual change in the structure and pigmentation of the feathers from an immature plumage to a neutral adult dress. This change appears to occur in steps as expressed in the successive molts required to produce the final plumage, but is actually caused by a slow physiological change, as has been proved by plucking feathers between molts.¹ This process is modified by an additional differentiation caused by a female or male hormone, which changes the neutral plumage to a typical female or male adult plumage. This latter process can be reversed by the removal of the gonads, while the change from the immature plumage to the "Neutral Plumage" seems to be irreversible and independent of any hormones thus far known.

It seems apparent that the time in which the organism changes from an immature to an adult condition (as expressed by the feathers growing at that time) is not entirely fixed. In most species it seems to occur at approximately the same age in all individuals, and in those species we do not find the abnormal plumages described above. In other species there is less uniformity. Certain individuals reach the adult condition earlier and acquire along with the first molt a plumage approaching the adult dress ("progressive" plumage), other individuals acquire a normal immature plumage with the first molt and with the second molt a normal adult plumage, and still other individuals do not reach the adult condition before the second year and thus acquire first a "retarded" adult plumage. Of course this sequence will be somewhat modified by the time and the number of molts in the various species and genera.

¹Kuhn, *op. cit.*, pp. 503-519.

A NEVADA FAUNA OF PLEISTOCENE TYPE AND ITS
PROBABLE ASSOCIATION WITH MAN

BY GEORGE GAYLORD SIMPSON

The purpose of this paper is to place on record in a brief and preliminary way the discovery of an interesting series of Pleistocene or early post-Pleistocene mammalian fossils and to give new evidence that man was associated with faunas of this type in North America.

The field observations and the collection here recorded were made by a party personally organized and led by Mr. Fenley Hunter, which worked from December 30, 1932, to February 3, 1933. Mr. Albert C. Silberling accompanied the expedition, and his long field experience was invaluable. The greater part of the material collected was very generously presented by Mr. Hunter to the American Museum of Natural History, where most of it has been prepared by Mr. Albert Thomson and a less amount by Mr. Carl Sorensen and others. The field observations here given are derived from the excellent notes provided by Mr. Hunter and Mr. Silberling, and the field photographs are also by Mr. Hunter. Dr. N. C. Nelson gave valuable advice and opinions concerning the probable association of man. Mr. Edwin Colbert assisted in the study of some of the fossil mammals. The writer assumes responsibility for the statements made, but the discoveries recorded are not his and he gratefully acknowledges the collaboration of all these gentlemen.

LOCALITY AND OCCURRENCE

The area explored is in Clark County, southeastern Nevada, and includes all the exposed strata of Pleistocene (or early post-Pleistocene) age along the main drainage of the Las Vegas Valley, northwest of the town of Las Vegas. The major part of the work was done from two camps, one at Indian Springs and a second, more important from the standpoint of collections made, five miles east of the Tule Springs turn-off from the main highway. The Valley east of Indian Springs is a structural valley between ranges of block-faulted mountains. The mountain bases are covered by conglomerates, the older parts of which are probably contemporaneous with the less coarse and more distinctly stratified Pleistocene beds of the middle of the Wash.

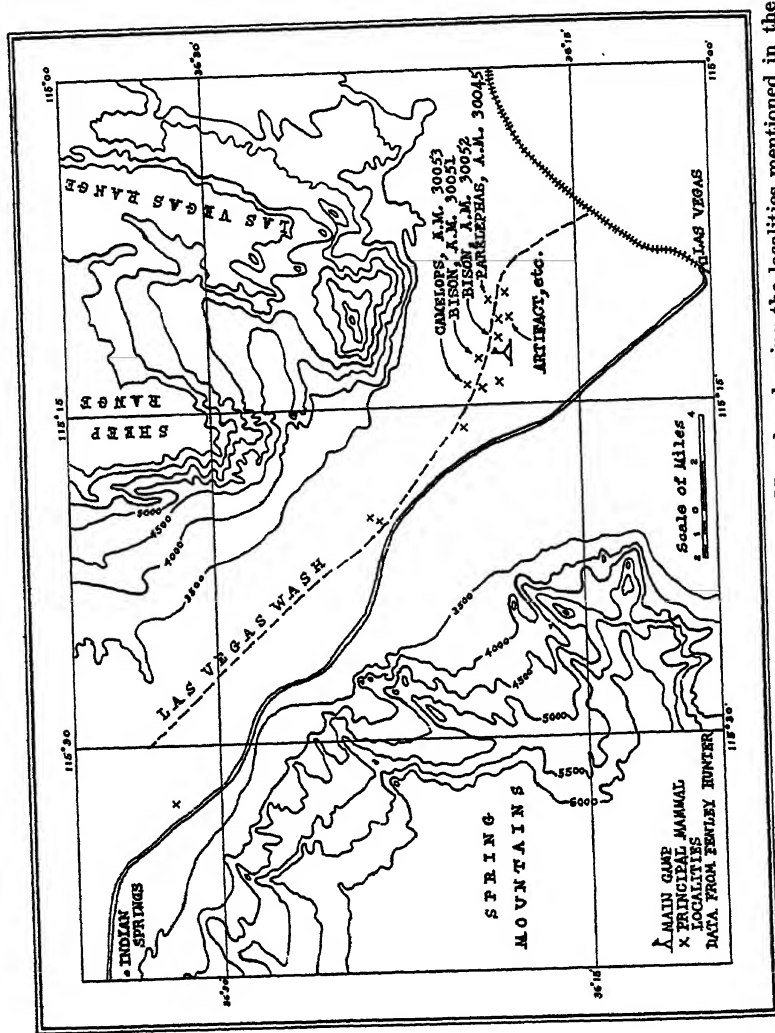


Fig. 1. Sketch map of part of Clark County, Nevada, showing the localities mentioned in the text. (Base from U. S. Geological Survey topographic sheet.)

The oldest part of the exposed series consists of tan-colored clays, into which are incised, or on which are disconformably superimposed, lighter-colored beds which seemed to the field observers to represent stream channel and flood plain deposits. All the identifiable fossils were found in these light-colored strata. Above them is another series of buff sandy clays, in their turn overlain by a series of lighter color. These upper beds yielded no identifiable fossils. In the opinion of Mr. Hunter and Mr. Silberling, the formation suggests aeolian action ex-



Fig. 2. Looking northeast from near the main camp, with the main wash of the Las Vegas Valley and exposed mammal-bearing Pleistocene beds in the foreground, and the southern end of the Las Vegas Range in the background.

cept for the supposed stream deposits in the lower part of the Pleistocene beds. As subsequently examined in the laboratory, the collection further indicates the presence of a body or bodies of fresh water of some duration. Numerous shells, especially from the artifact locality but said to occur throughout the area in the mammal-bearing beds, clearly are aquatic forms. These have not yet been studied, but they appear to include members or relatives of the genera *Pisidium*, *Planorbis*, *Physa*,

and *Amnicola*. Such a molluscan fauna suggests the shallow freshwater lakes and ponds of the present West, and also the marginal deposits of the Pleistocene lakes of the Great Basin. The mammal beds may represent a period of higher precipitation, followed by a more arid time. In this as in other respects, present data point to the existence in this area of very important evidence, without now permitting its full interpretation.

The series of old sediments has now been extensively eroded, while, as in so many western localities, another more recent and relatively minor shifting of the sedimentary balance is seen in the sand and gravel building up the floor of the Las Vegas Wash, itself incised in the much more extensive deposits of a previous cycle.

There are five major exposures of the old sediments, but only two of these are eroded deeply enough to expose the horizon of identifiable fossils. In the lower levels of the upper beds were found some bone fragments of no value. The mammal-bearing series, proper, appears to be very rich, as shown, for example, by the discovery of mammoth remains at fifty-two different localities. The great majority of the fossils were dissociated, chiefly single and often broken bones and teeth but also rarer jaws and skulls. In only one case, that of a mammoth listed below, were different associated elements of one animal found. Probably most of the remains were transported from the higher areas on each side of the Wash before burial. The skulls found are somewhat crushed and the preservation in general is rather poor. Most of the bones are very light, with loss of organic matter but little or no secondary mineralization.

The short time available, most of which was spent collecting fossil vertebrates, and the unfavorable weather conditions precluded extensive stratigraphic and physiographic study, but indicated its desirability and the probability that it would give clear and very important results. Like the fauna, as suggested below, the physical data now at hand indicate great historical antiquity for the deposit and show it to be either Pleistocene or earliest post-Pleistocene. A more precise statement must follow further work.

MAMMALIAN FAUNA

The identifications here given are preliminary and subject to some possible revision with more extensive collections and more intensive study, but they give an adequate idea of the general nature of the fauna.

Fossils were collected from three general localities:

A. Eight miles east-southeast of Indian Springs, between present highway and old railroad grade:

Odocoileus sp. Foot bones.

B. About four miles south-southeast of Corn Creek Springs:

Lepus sp. Fragmentary limb bones.

Parelephas ?columbi. Molars.

Camelops sp. Isolated bones.

Odocoileus sp. Isolated bones.

C. Within a radius of three miles of the principal camp of the party, which was located about ten miles north-northwest of Las Vegas, about five miles east of the Tule Springs turn-off from the main highway, three hundred yards from the south rim of the Big Wash. This is a rich area where the greater part of the collection was made.

Thomomys ?perpallidus. One specimen, lower teeth from the artifact locality.

Nothrotherium sp. A single specimen, an imperfect cranium lacking face or teeth, Amer. Mus. No. 30061. Although apparently somewhat aberrant, this cranial fragment appears to be of this genus and may even be *N. shastense*. Detailed comparison has not yet been possible.

Parelephas columbi. This is far the most abundant animal in the collection. Several isolated teeth and other fragments appear to represent a single species, considered as the Columbian mammoth. A skull, distorted but nearly complete, and the poorly preserved lower jaw and some skeletal elements of the same individual were found, apparently representing a very old female (Amer. Mus. No. 30045). This was the only discovery of associated parts of one individual of any species of mammal.

Equus pacificus. Two large upper molars appear to be of this species and probably some of the larger lower teeth belong to this species also. Horses are not as yet well represented.

Equus spp. A single small tooth from one mile west of camp seems surely to be distinct from *E. pacificus* but cannot be exactly identified. Among the other lower teeth from various localities, there are several, poorly preserved, which seem to represent a horse of intermediate size and may belong to a third species, but do not surely do so.

Camelops hesternus. This species was abundant, a mandible with the complete dentition of both sides being found (Amer. Mus. No. 30053), as well as many isolated teeth and skeletal parts.

Odocoileus sp. Rare remains of a small deer, doubtless of this genus, include the base of a shed antler and some isolated bones, but no teeth.

Bison aff. *occidentalis*. Two nearly complete bison skulls (Amer. Mus. Nos. 30051 and 30052) and several teeth and other fragments are in the collection. This is not *Bison occidentalis*, by current standards of species making, and would have to be placed in a new species. It belongs, however, to the general group of *B. occidentalis*, *crassicornis*, *chaneyi*, *taylori*, *texanus*, and possibly some others, without

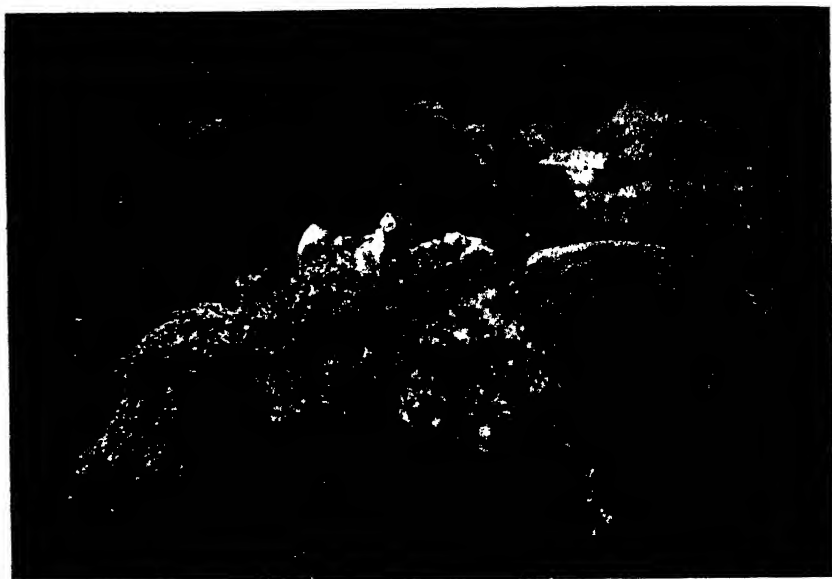


Fig. 3. Bison skull, Amer. Mus. No. 30052, in situ.

resembling any one of these closely enough for specific reference. It differs from typical *occidentalis* chiefly in being more robust, with broader frontals and longer and stouter horn cores. I decline to erect another species in this abused group, without adequate revision, and reserve these specimens for the use of a future reviser.¹

¹The current belief that some fifteen to twenty species of bison, all of which inhabited the United States during the Pleistocene, are now represented in collections, with the implication that the actual number of species may have been twice that or even more, seems to me to border on the absurd. The criteria often employed for defining these supposed species do not seem to have been selected or evaluated on a really sound scientific basis. By these criteria, the present specimens would represent one and perhaps two new species just as distinct as any of those now in the lists, but it seems highly inadvisable to continue the erection of such "species," and the matter is left *sub judice*.

This fauna is obviously of Pleistocene character. Of the forms of mammals so far known, at least 65% are extinct and these all belong to species or genera apparently confined to the Pleistocene. On this basis, and also on the basis of the presence of horses, camels, etc., some students would be inclined to place the fauna in the Early Pleistocene; indeed the correlations devised by the late O. P. Hay would probably place it as very earliest Pleistocene. Yet it seems increasingly doubtful whether these considerations are really valid. The percentage method of correlation has been rather thoroughly discredited, except in a highly modified form not in any event applicable to a fauna, like this, in which very few species are known and these almost exclusively of one faunal element—the large herbivores. As to correlation on differential extinction, as I have elsewhere pointed out,¹ this involves the belief that the exact or approximate time of extinction of a number of common genera is known and the hypothesis that this time was appreciably the same all over the United States, or North America, and at present neither this belief nor this hypothesis seems to be justified. The subject is very complex and confusing, but the whole trend of recent evidence seems to be toward the theory that many of the animals once considered as typical of the older Pleistocene really survived to a relatively recent date, at least in certain areas, some of them perhaps even into the geological epoch Recent.² That so many mammals should have survived the Pleistocene, only to die out toward or slightly after its end, is a very extraordinary thing. Its causal explanation, while not beyond conjecture, remains mysterious, but at present the evidence seems to indicate it as a fact.

PROBABLE ASSOCIATION OF MAN

At a locality one-half mile east of the main camp (the location of which is given above) on the south side of a short coulee 200 yards from the Big Wash, there was found highly suggestive if not absolutely conclusive evidence of the coexistence of man with the fauna listed

¹For instance in: Simpson, G. G. 1929. 'Pleistocene Mammalian fauna of the Seminole Field, Pinellas County, Florida.' *Bull. Amer. Mus. Nat. Hist.*, LVI, pp. 561-599.

²For a vigorous but not entirely accurate protest against this point of view see: Hay, O. P. 1930. 'Remarks on Dr. George G. Simpson's work on the Pleistocene paleontology of Florida.' *Journ. Washington Acad. Sci.*, XX, pp. 331-340.

It is not proposed to answer Doctor Hay's arguments, which he can no longer defend and which are probably accepted by few of his colleagues, beyond reaffirming the essentials of my former views (not particularly original with me) and suggesting as a matter of record that Doctor Hay's expression of my opinions is in some respects not what I had myself tried to say. It may also be noted that, due to a long absence from this country, I did not see a copy of Doctor Hay's attack until after the close of his distinguished and eminently useful career, and that the following article, although it appears by coincidence to have answered some of his arguments, was written before his paper appeared and published before the latter was seen: Simpson, G. G. 1931. 'Origin of mammalian faunas as illustrated by that of Florida,' *Amer. Nat.*, LXXV, pp. 258-276.

above. There was here a very local stratum in which isolated teeth and bone fragments were particularly abundant. In quarrying for these, a flake of obsidian was found. This was in undisturbed matrix at a depth of four feet six inches and well in from the eroded bank. The actual discovery was made by Albert C. Silberling who has had much experience in collecting fossils, especially in the Fort Union, and well appreciates the importance of distinguishing contemporaneous and redeposited material. He asserts that the obsidian flake was originally deposited in the ancient stratum as found, and Mr. Hunter, who was



Fig. 4. The "artifact locality." The artifact was derived from the deeper part of the cut in which the men are working. The pick held by the man to the left points to the exact site of the artifact.

also present, is strongly of the same opinion. The obsidian was left in undisturbed matrix, with only one side exposed, and was brought to the Museum in a bandaged block. There it was removed and cleaned by me in the presence of Dr. N. C. Nelson, Mr. Hunter, and Mr. Junius Bird. A small piece, an angle broken off the main flake, was found in the matrix about 3 mm. from the flake. Doctor Nelson states that the obsidian flake is not an implement, that is, had not been fashioned to a

definite and completed form for use, but that it is with high probability an artifact, that is, owes its present form to some activity of man. As shown in the figure, one side has been irregularly flaked, while the other shows a definite bulb of percussion and a single fracture surface. A small piece of bone, indeterminate but fossilized to the same degree and in the same way as others unquestionably belonging to extinct species in this formation, adhered to the lower side of the artifact.

The probability that this obsidian flake had been transported by man is greatly increased by the fact that no other obsidian in any form was observed in the formation or anywhere in the surrounding region. The evidence is further substantiated in an important way by the presence of charcoal. This was scattered in small amounts



Fig. 5. Supposed artifact. A, Irregularly chipped side (photographed in reflected light). B, Side with single fracture surface (photographed in transmitted light). Natural size.

through the bone pocket but the greater part of it was concentrated in three small, well defined areas, in one of which the obsidian occurred. These strongly suggest campfire sites, although without large stones or other suggestion of a definitely constructed cooking place. The stratum with the teeth, bones, obsidian, and charcoal lay above an eroded surface in the tan-colored lower beds, and was evidently at or very near the same level as the majority of the fossil mammals found in the formation in this area. With one exception (at the same level and a short distance away from the major occurrence), no charcoal was otherwise found in the region investigated, from Las Vegas to Indian Springs.

The mammalian remains in immediate association with the obsidian and charcoal belonged to the following forms, so far as identified:

Thomomys ?perpallidus. Lower teeth of one individual.

Equus pacificus. Two upper and probably some lower teeth.

Equus sp. Several lower teeth probably of a smaller species.

Also an astragalus of undetermined affinities.

Camelops hesternus. Numerous teeth, a fragmentary jaw and a phalanx.

Odocoileus sp. Isolated foot bones.

Bison sp. Teeth and a fragmentary jaw. Apparently an extinct form, and probably the same as the two skulls listed above, one of which was found in the same small coulee and at the same level.

Some of the large bone fragments apparently represent mammoth, and in any event the occurrence of the latter in the same beds and up to fifteen feet higher stratigraphically in the same area indicates its contemporaneity. The majority of the camel teeth are of immature or even juvenile individuals, although the fragmentary jaw is of a very old individual. Several of the horse teeth are also of young individuals. The broken bone fragments so numerous in this pocket may represent human activity, although no distinct tool marks are visible on them.

In itself, this occurrence is not absolutely conclusive, but it is strongly suggestive and is recorded as a datum of some importance in the rapidly accumulating evidence of the association of man with faunas of this type in North America, and as an indication of an important field for further investigation.

59.83, 6 (85)

STUDIES OF PERUVIAN BIRDS. XI

THE GENERA *TARABA* AND *SAKESPHORUS*

By JOHN T. ZIMMER

I am greatly indebted to Dr. Herbert Friedmann of the U. S. National Museum, Washington, D. C., for the loan of the type of "*Thamnophilus hollandi*" used in the following study.

Names of colors when capitalized indicate direct comparison with Ridgway's 'Color Standards and Color Nomenclature.'

***Taraba major transandeanus* (Sclater)**

Thamnophilus transandeanus SCLATER, 1855, P. Z. S. London, XXIII, p. 18—Guayaquil, s. w. Ecuador; cotypes in British Mus.

A single male from Milagros is perfectly comparable to specimens from the west coast of Ecuador. The only other Peruvian locality is Tumbes, recorded by Taczanowski.

A male from Guainche, Ecuador, has the under tail-coverts largely grayish with dusky bands and whitish tips rather comparable to *granadensis*; one of the coverts is still left from the rufous juvenal dress which appears also on the wings. Another male from Zaruma is similar but with more juvenal feathers, and a third, from Manaví, shows a slight tendency in the same direction. In the rest of the Ecuadorian series, these coverts are black with white tips but without gray. Owing to the separation of this region from the range of *granadensis* it is debatable whether the variation is toward *granadensis* or whether it is not toward *melanurus* which sometimes has the normally white under tail-coverts inclined toward grayish with dusky barring.

Further account of *transandeanus* is given below in the general discussion under *T. m. melanurus*.

***Taraba major melanurus* (Sclater)**

Thamnophilus melanurus SCLATER, 1855 (April), Edinb. N. Philos. Journ. (N.S.) I, p. 233—part; River Ucayali, e. Perú; ♂ imm.; British Mus.

Thamnophilus melanurus debilis BERLEPSCH AND STOLZMANN, 1896, P. Z. S. London, p. 379—La Merced, Perú; cotypes in Berlepsch Collection, Frankfurt, and Warsaw Museum.

A series of birds from numerous localities in Perú shows the existence of much individual variation with a tendency toward various

extralimital forms at different parts of the boundary. In extreme north-western Perú, the west-Ecuadorian form, *T. m. transandeanus*, reaches Peruvian territory, but in the rest of the country, in the humid tropical valleys, only a single form can be satisfactorily distinguished. This form, *melanurus*, reaches out into eastern Ecuador and western Brazil but finds the center of its distribution near the Río Ucayali which is also its type locality and where the resident form has characters of the best average nature.

In southeastern Perú, the females are somewhat paler above than Ucayali birds, with a noticeable brownish tinge and with a slight suggestion of pale tips on the outer rectrices. They show a distinct approach toward typical *major* of the Paraguay-Argentina-Bolivia region. The males are inseparable from *melanurus*, without any unusual development of white on the tail, not as much as is shown by some Ucayali examples. Since another degree of intermediacy is shown by the inhabitants of northern Bolivia (discussed on a later page), while southeastern Bolivia harbors true *major*, it is best to leave the southeast-Peruvian series with *melanurus* and to point out their variational tendency.

I have no females from the Chanchamayo Valley whence "*debilis*" was described, but three males from Junín show no differences from skins from other parts of Perú. The bill is no smaller and the tarsi no longer, while the white tips of the upper wing-coverts and the outer rectrices are white in other skins as well as in the Junín examples.

West of the Ucayali in northern Perú (except on the Pacific coast), across the middle Marañón to the Chinchipe Valley, and thence eastward across Perú and Ecuador to beyond the Napo, there is a tendency toward a greater development or extension of blackish on the facial region of both sexes. This is evidenced in the male sex by the spreading of the black from the malar region to include a line of variable width on the upper border of the feathering on the base of the mandible, just below the gape. In the female sex, the lores, a short extension over the eye, and a subocular space including the anterior portion of the auriculars may be conspicuously blackish instead of rufous with more whitish lores. Not all of the northern examples show these characters and, while none of the Ucayali males have any black below the gape, some of the Ucayali females have the facial region as dark as the more lightly marked females from the other localities. A male and a female from "Napo" are inseparable from Ucayali skins and are less like others from San José and the mouth of the Curaray, in the Napo region. In spite of the occurrence of some well-marked variational tendencies in the northern part of Perú,

therefore, the racial characteristics do not appear to be fixed enough to warrant the application of a new name.

As a matter of fact, the black on the face of both sexes is a mark of approach toward *granadensis* of eastern Colombia where it is of more regular occurrence. The Ucayali birds, on the other hand, are nearer to *borbae*. So much individual variation is shown in all these forms that there is no sharp line of division anywhere, though certain subspecies are relatively distinct in certain respects. Thus the white-tipped black under tail-coverts of *transandeanus* are lightened to gray with dusky bands and a white tip in *granadensis*, while in *melanurus* these feathers, which are pure white on all exposed portions, frequently have dusky or grayish median areas and may resemble those of *granadensis* except for broader white tips.

Peruvian localities from which *melanurus* (including "*debilis*") has been recorded, except those given in the subjoined list of specimens, are Pebas, Samiría, Chayavitas, Nauta, Santa Cruz, Moyobamba, Pangoa, Bellavista, La Merced, Yahuar Mayo, San Gaban, and Chaquimayo.

In the examination of Bolivian material to determine the affinities of southeast-Peruvian specimens, much variation was found in the direction of contiguous forms, as is the case in *melanurus*. It is doubtful if the variations deserve nomenclatorial recognition.

Birds from northern Argentina are certainly inseparable from Paraguayan skins of typical *major*, though Laubmann, in describing his "*kriegi*" from southeastern Bolivia, referred his series from Argentina to it. I have no material from southeastern Bolivia, but the description of *kriegi* and the characters shown by the Argentinian specimens exactly fit the Paraguayan birds at hand. The error of separation appears to have arisen through taking birds from Goyaz, Brazil, as typical *major* whereas they evidently approach *stagnus*, at least in some respects.

A series from Matto Grosso, Brazil, shows no marked divergence from typical *major* in either sex. Five males from Todos Santos and Reyes, Bolivia, including the type of "*virgultorum*" are likewise inseparable from males of *major*, but a female from the "Falls of the Madeira," near the junction of the Beni and the Mamoré, is decidedly darker and more rufous in dorsal coloration than any of the Matto Grosso-Argentina-Paraguayan series and is purer white beneath, without the buffy tinge of *major*. In spite of this, it falls far short of the depth of coloration in female *borbae* as exemplified by numerous specimens from both sides of the Madeira near its mouth and as far up as Humaythá.

Another female from Porto Velho, Brazil, not far above Humaythá, is even closer to typical *major* and not at all like *borbae*. Evidently the range of *borbae* does not extend southward beyond the mouth of the Gy-Paraná though in the region of northern Bolivia a definite intergradation takes place with *major*.

The female from the Falls of the Madeira is not unlike the females from southeastern Perú in many respects and it might be thought that they could be joined in a separable form to be called "*virgultorum* Cherrie," but the southeast Peruvian males are decidedly closer to *melanurus* and the Bolivian males are inseparable from *major*. Consequently such a form would be extremely unstable in its characters and it is better left in synonymy.

Two females from Teffé, Brazil, are of somewhat doubtful affinity. There is little difference, at best, between *melanurus* and *borbae*, and between the females of the two there is only a slight distinction in the tone of the upper parts, *melanurus* having a faintly brownish hue observable only on direct comparison with *borbae*. The Teffé females seem to agree better with *melanurus*. This is probably the correct assignment since males of *borbae* from the left bank of the Madeira are a little less positively marked than those from the right bank, showing that even greater distinction may be expected west of the Purús.

A female from Rio Grande, Minas Geraes, is not typical either of *major* or *stagurus*. There is no buffy tinge on the under parts as in *major*, and even the flanks, which are somewhat buffy in *stagurus*, are more grayish than buff. There is some blackish shading about the eye and traces of fine dusky shaft-lines on the breast, but the upper parts are dark as in *stagurus*, to which I refer the specimen provisionally.

The tendency to develop an extension of facial black, observed in north-Peruvian birds and just noted in the Goyaz examples of *stagurus*, occurs also in other subspecies. Some of the females of *semifasciatus* from near the foot of Mt. Duida also show this character as a variable feature, not present in all the skins from that region. Possibly here it is a step in the direction of *duidae* where it is constant and marked, but it may also show the affinity of *granadensis* which is not far away to the westward. Hellmayr (1924) gives the range of *semifasciatus* as extending up the Orinoco to Munduapo, but it goes beyond to the Cassiquiare and down the Negro to its mouth, at least on the left bank (San Gabriel, Santa Isabel, and Manaus).

I have already noted that *granadensis* shows the regular occurrence of black on the sides of the head in the females and black below the gape

in the males. Chapman (Amer. Mus. Novit., No. 380, p. 17, 1929) has noted that "females of *transandeanus* from throughout the greater part of its range approach *duidae* in their blackish loreal, ocular, and aural regions," but the fact is that this condition does not exist in typical Ecuadorian specimens though it holds for Colombian skins, where it is accompanied by a distinctly darker hue of rufous on the upper surface. The males, furthermore, are rather uniform in respect to the presence of a black line on the upper part of the mandibular feathering below the gape, which again is not the case in Ecuadorian specimens. The Ecuadorian series is consistent in these respects (with which the male from Milagros, Perú, agrees), and the Colombian (Pacific coast and Cauca Valley) series is equally consistent except near the Ecuadorian border at Barba-coas where individual variation forms the transition, with both extremes in evidence.

In Central America the characters of the west-Colombian birds are continued and skins from various localities agree in the details mentioned, though other differences occur. Griscom (Bull. Amer. Mus. Nat. Hist., LXIV, p. 232, 1932) has reinstated *melanocrissus* as a valid form extending down the Caribbean coast from Mexico to northeastern Panamá though stopped on the Pacific side by the occurrence of "*transandeanus*" in western Costa Rica and with many intermediate examples occurring in southern Central America.

The recognition of *melanocrissus* appears to be justifiable in spite of the broad area of intergradation. The same type of intergradation and variation exists in other subspecies of the group as detailed elsewhere in this paper, and the extremes, which are quite distinct, occur in widely separated regions. I have seen no Mexican material, but in three males from Guatemala there is only a negligible suggestion of whitish at the tips of the under tail-coverts, much less than in any Colombian birds. In Nicaraguan males, the amount of white on these coverts tends to increase. A male from "Savala" is like the Guatemalan skins; one from Los Sabalos has a moderate amount of white, but one from somewhere near the borders of the state of Matagalpa has rather broad white tips. Geographically, all these birds should be *melanocrissus*. The type of Lawrence's "*hollandi*" came from Greytown, on the Caribbean coast of southern Nicaragua, and it is without white on the under tail-coverts, being easily recognizable as *melanocrissus*.

Some of the Costa Rican birds also are intermediate but those from the eastern side of the divide have an average of less white on the under tail-coverts than those from the west, though a male from Limón has the most of any of the series examined.

In Panamá, one male from Remedios, on the Pacific side, has no appreciable white on these coverts but the feathers in question belong to the juvenal plumage and may not be typical. Males from the neighborhood of Bocas del Toro have an average of less white on these coverts than those from all the rest of the country, which coincides with Griscom's analysis of the situation.

The females of *melanocrissus* require more study than the material at hand will permit. The two Guatemalan females have a minimum of blackish about the eye. Most Nicaraguan birds have more than the Guatemalan skins, but one from Vizagua has none, and the Costa Rican have the same as the average Nicaraguan. Females from Panamá agree with those from Costa Rica except one bird from Lion Hill which is like the Guatemalan examples in lacking decided black in this region. Honduran and Mexican specimens should be examined to determine the relative constancy of this variation.

With "*hollandi*" relegated to the synonymy of *melanocrissus*, the west-Colombian birds are left without a name. The form may be known as follows.

Taraba major obscurus, new subspecies

TYPE from Alto Bonito, Antioquia, Colombia; altitude 1500 feet. No. 133,376, American Museum of Natural History. Adult female collected February 23, 1915, by L. E. Miller and Howarth Boyle. Original number 11,429.

DIAGNOSIS.—Similar to *T. m. transandeanus* but females darker rufous above and on wings and tail; lores, supraocular and subocular spaces, and anterior part of auriculars distinctly blackish, not uniform with top of head nor with lores whitish. Males differ from *transandeanus* only by having the black of the malar region extended below the gape to the upper part of the feathering at the base of the mandibles.

RANGE.—Central and western Colombia in the Cauca Valley and on the whole western coast, extending north into Panamá (except in the northern section of the Caribbean coast-region) and, on the Pacific slopes, at least as far north as western Costa Rica.

DESCRIPTION OF TYPE.—Back Chestnut, with top of head inclined toward Bay and with the tips of the feathers slightly darker; lores blackish with the same obscurity extended over the eye and below it to the anterior portion of the auriculars, reaching also to a narrow line on the mandibular feathering below the gape; remainder of auriculars and sides of head and neck like the back; a large, concealed patch of silky white on the mantle. Most of under parts white with outermost border of the sides light Chestnut; flanks somewhat grayish, becoming dark brown posteriorly; thighs Amber Brown with white tips; under tail-coverts light Auburn with very narrow whitish tips. Wings Fuscous, with outer margins near Carob Brown; inner margins narrowly and not sharply whitish; upper wing-coverts the color of the back with faint suggestions of pale tips; tail Carob Brown. Bill black (in dried skin);

feet slaty brown. Wing, 97 mm.; tail, 71; exposed culmen, 25; culmen from base, 31; tarsus, 36.5.

REMARKS.—Males have the top of head and back black with a concealed patch of white on the mantle; upper tail-coverts black, usually with narrow white tips on some of the feathers. Loes and sides of head and neck black including also a line of variable width on the feathering at the base of the mandibles below the gape. Chin, throat, breast, and belly white; sides of breast with the outermost feathers black or with their outer webs largely black; flanks grayish or white; thighs with feathers black at base, white at tip; under tail-coverts black with narrow white tips. Tail black (rarely with faint white tips on outermost rectrices); wings black, with inner margins of remiges white or whitish except at tips; upper wing-coverts black with white tips usually absent from primary-coverts; alula with white tips or sometimes white outer margins; under wing-coverts white. Bill black (in dried skins); feet slaty. Wings, 89–97 mm.; tail, 65–75; exposed culmen, 25–30.5; culmen from base, 31–35; tarsus, 34–36.5.

Two young males from Baudo and La Vieja, Choco, Colombia, have the chest-feathers tipped with blackish and the lesser upper wing-coverts black without white tips, but an equally young male from Río Barraton, Cauca Valley, disagrees in both particulars. An adult male from Savala, Matagalpa, Nicaragua, has even less white on the wings and only a trace of white at the tips of the under tail-coverts, being presumably near *melanocrissus*; though a male from the Río San Juan and one from near the state of Matagalpa, Nicaragua, both have broad white tips on these feathers; there are only faint traces of dusky tips on the breast of the Savala bird. A young male of *melanocrissus* from Guatemala has still less white on the upper wing-coverts and under tail-coverts but has the dusky tips on the breast-feathers a little stronger than the Savala skin. The black tips on the breast are somewhat developed in a young male of *transandeanus* from Naranjo, Ecuador, and the white tips of the under tail-coverts are much reduced, but the upper wing-coverts are broadly tipped with white (or cinnamon-buff on the juvenal feathers).

I have already called attention (Amer. Mus. Novitates, No. 584. p. 11, 1932) to the fact that the young bird described by Wied as the nestling of "*Myioturdus tetema*" (= *Formicarius colma ruficeps*) is, in reality, a young *Taraba major* subspecies. The subspecific determination is impossible in the absence of a definite locality for the specimen, but it is *major*, *semifasciatus*, or *stagurus* judging by the pattern observable on such of the rectrices as have begun to appear.

Before closing this account, a word may be said about the generic name *Taraba*. As originally founded, some seventeen names (accepted for sixteen species) were included by Lesson, only two of which, *magnus* and *albiventer*, are among those referable to forms now included in the genus. Gray, in 1855, designated *stagurus* as the type and Sclater, in 1890, designated *major* as the type. Neither of these names was given by Lesson although *magnus* is an unquestionable synonym of *major* and *albiventer* is a nearly certain synonym of *stagurus*. Presumably neither Gray's nor Sclater's designations are valid. I judge that Sherborn has reached the same conclusion since in the 'Index Animalium,' Sect. 2, Vol. T-Z, p. 6832, 1931, he has formally designated "*Tamnophilus magnus* Wied" [= *Taraba major major*] as type of the genus.

SPECIMENS EXAMINED

T. m. major.—PARAGUAY: Trinidad, 1 ♂; "Front of Concepcion," 2 ♂, 1 ♀; Makthlawaika mission, 2 ♂, 1 ♀. ARGENTINA: Embarcación, 8 ♂, 9 ♀; Perico, Jujuy, 6 ♂; Suncho Corral, 1 ♂, 2 ♀; Avia Terai, 1 ♂, 1 ♀; General Pinedo, 1 ♂, 1 ♀; Rosario de Lerma, 1 ♀; Sarmiento, 1 ♀; Concepción de Tucumán, 2 ♂¹, 1 ♀¹; Trancas, 1 ♂¹. BRAZIL: Chapada, Matto Grosso, 12 ♂, 4 ♀; Urucum de Corumbá, 5 ♂, 3 ♂¹, 4 ♀; Belvedere de Urucum, 1 ♂; Tapirapoan, 1 ♂, Abrilongo, 1 ♀; Cuyabá, 1 ♀; Descalvados, 1 ♀; 1 ♀¹; Fazenda San Juan, Cuyabá, 1 ♂; Rio San Lorenzo, 1 ♂, 1 ♀; Piraputanga, 1 ♂¹; Porto Velho, Rio Madeira, 1 ♀. BOLIVIA: Todos Santos, 3 ♂ (incl. type of "*virgultorum*"); Reyes, 2 ♂; Falls of the Madeira, 1 ♀².

T. m. stagurus.—BRAZIL: Bahia (various localities), 14 ♂, 7 ♀, 1 ♂¹; Espirito Santo, 1 ♂, 2 ♀; Piauí, 6 ♂, 7 ♀, 1 ♂¹; Ceará, 1 ♂, 8 ♂¹, 8 ♀¹; Maranhão, 11 ♂, 2 ♀, 7 ♂¹, 5 ♀¹; São Paulo, Avandava, 1 ♂; Goyaz, Philadelphia, 1 ♂; Minas Geraes, Rio Grande, 1 ♀².

T. m. semifasciatus.—BRAZIL: Rio Tocantins, Baixo, 3 ♂; Rio Xingú, Porto de Moz, 2 ♂, 2 ♀; Rio Tapajoz, Tauary, 2 ♂, 1 ♀; Piquiatuba, 1 ♂, 2 ♀; Caxiricatuba, 2 ♂; Santarem, 1 ♀; Igarapé Amorin, 2 ♂, 2 ♀; Rio Amazonas, Villa Bella Imperatriz, 2 ♂, 2 ♀; Rio Jamundá, Faro, 4 ♂, 3 ♀; Arumanduba, 1 ♂; Obidos, 1 ♀; Rio Negro, Manaos, 2 ♂; Santa Isabel, 1 ♂; San Gabriel, 1 ♂; Serra da Lua, 2 ♂¹. VENEZUELA: (Rio Cassiquiare and foot of Mt. Duida), 8 ♂, 6 ♀; Munduapo, 1 ♂, 1 ♀; La Unión, 2 ♂, 2 ♀; El Pilar, 1 ♂; Carenage, 1 ♀; Quebrada Seca, 1 ♀; Cristóbal, Colón, 2 ♂, 1 ♀; San Antonio, 1 ♂; Cuchivano, 1 ♂; La Latal, 1 ♀; BRITISH GUIANA: 1 ♂, 3 ♂¹; Dutch Guiana, 1 ♂¹, 1 ♂, 1 ♀.

T. m. duidae.—VENEZUELA: (Mt. Duida, 4700–6700'), 5 ♂, 4 ♀ (incl. type).

T. m. borbae.—BRAZIL: Rio Madeira (right bank), Borba, 1 ♂, 1 ♀; Igarapé Auará, 4 ♂, 4 ♀; (left bank), Rosarinho, 4 ♂, 7 ♀; Santo Antonio de Guajará, 1 ♂, 2 ♀; Humaythá, 1 ♂, 1 ♀.

T. m. melanurus.—BRAZIL: Teffé, 2 ♀. PERÚ: Astillero, 1 ♂, 1 ♀; Candamo, 3 ♂, 2 ♀; Tulumayo, Junín, 3 ♂; mouth of Río Urubamba, 1 ♂; Puerto Bermúdez,

¹Specimens in Field Museum of Natural History, Chicago.

²Not typical.

Río Pichis, 1 ♂¹; Santa Rosa, Río Ucayali, 3 ♂, 2 ♀; Lagarto, 3 ♂, 7 ♀; Sarayacu, 1 ♂, 4 ♀; Río Amazonas, Orosa, 2 ♂, 1 ♀; Río Chinchao, Vista Alegre, 1 ♂¹, 2 ♀¹; Río Seco, west of Moyobamba, 3 ♂, 5 ♀; Jaen, 1 ♀; Río Chinchipe, Perico, 3 ♂, 3 ♀; Anayacu, 1 ♂. ECUADOR: Zamora, 3 ♂; below San José, 1 ♂; mouth of Río Curaray, 1 ♀; "Napo," 1 ♂, 1 ♀.

T. m. transandeanus.—PERÚ: Milagros, 1 ♂. ECUADOR: Bucay, 1 ♂; Chone, 1 ♂; Manaví, 1 ♂; Esmeraldas, 1 ♂, 1 ♀; Río de Oro, 1 ♀; Zaruma, 1 ♂; Naranjo, 1 ♂, 3 ♀; Guainche, 1 ♂; Santa Rosa, 1 ♂, 1 ♀; Alamor, 1 ♀; Mindo, 1 ♂.

T. m. obscurus.—COLOMBIA: Barbacoas, 8 ♂, 3 ♀; San José, 1 ♂, 1 ♀; Baudo, 1 ♂; La Vieja, 1 ♂; Río Frio, 1 ♂, 3 ♀; Río Barraton, 3 ♂; Río Lima, 1 ♀; Palmira, 1 ♂; Alto Bonito, 3 ♂, 3 ♀ (incl. type). PANAMÁ: (Lion Hill), 3 ♂, 1 ♀; Chiriqui, Boqueron, 1 ♂; Cape Garachiné, 1 ♂, 1 ♀; El Real, Río Tuyra, 5 ♂, 1 ♀; Boca de Cupe, Río Tuyra, 1 ♂; Cituro, 1 ♀; Chepigana, 1 ♀. COSTA RICA: Pozo del Río Grande, 2 ♂, 1 ♀; Boruca, 1 ♀; Puerto Jimenez, 1 ♂, 2 ♀. †

T. m. granadensis.—COLOMBIA: Villavicencio, 2 ♂; Honda, 1 ♂; Buena Vista, 1 ♂; Malena, 1 ♀. VENEZUELA: El Limón, 1 ♂.

T. m. melanocissus.—GUATEMALA: Finca Chama, 2 ♂, 2 ♀; (no locality), 1 ♀. NICARAGUA: Los Sabalos, 1 ♂; Savala, 1 ♂, 1 ♀; Matagalpa, 1 ♀; Vizagua, 1 ♀; "state of Matagalpa or borders," 1 ♂; Greytown, 1 ♂² (type of "*Thamnophilus hollandi*"). COSTA RICA: Limón, 1 ♂; Guapiles, 1 ♀; Guacimo, 1 ♂, 1 ♀; Atalanta, 1 ♂, 2 ♀; Hacienda La Iberia, 1 ♀. PANAMÁ: Cocoplum, 4 ♂, 1 ♀; Almirante, 3 ♂, 3 ♀.

***Sakesphorus canadensis loretoyacuensis* (Bartlett)**

Thamnophilus loretoyacuensis BARTLETT, 1882, P. Z. S. London, p. 373—Loretoyacu, Río Marañón, n. e. Perú; ♂ ♂, ♀; cotypes in British Mus.

A single Peruvian skin of this bird is at hand,—one of the specimens collected by Bartlett on the "Upper Ucayali," possibly near Cashiboya. For comparison I have a pair from Teffé, Brazil, five males and three females from the Rio Negro, and a female and a young male from the lower Rio Branco, all of which seem to represent the same form. There is a little variation in the color of the mantle in the males which varies from nearly all black with some indistinct, dark gray margins to dark brown with blackish shaft-stripes, both extremes coming from Muirapinima, a locality on the Rio Negro about halfway between Manaos and the mouth of the Rio Branco, though on the right bank.

The females are very like those of typical *trinitatis* except that the back is darker brown or rufous brown.

Records of *loretoyacuensis* from Perú are from the Upper Ucayali, Chamicuros, and Loretoyacu, the last-named locality in the territory ceded by Perú to Colombia in 1926.

¹Specimens in Field Museum of Natural History, Chicago.

²Specimen in U. S. National Museum, Washington, D. C.

The farthest point up the Negro from which I have specimens is Yavanari, also on the right bank, a short distance above Santa Isabel (left bank), whence Pelzeln recorded the bird (as *Thamnophilus atricapillus*).

Six examples from the foot of Mt. Duida are noticeably different from the series of *loretoyacuensis* and even more distinct from most of the Venezuelan specimens available for comparison though there are certain interesting connections with the northern series which have appeared after careful study. In any case, the Duida birds represent an extreme type of coloration which is best named and described before any further discussion is given. This new form may, therefore, be characterized as follows.

***Sakesphorus canadensis fumosus*, new subspecies**

TYPE from Lalaja, Río Orinoco, Venezuela; altitude 325 feet. No. 237,356, American Museum of Natural History. Adult male collected February 26, 1929, by the Olalla brothers.

DIAGNOSIS.—Similar to *S. c. loretoyacuensis* of extreme eastern Perú and north-western Brazil, but noticeably darker on the under surface. Males without the customary white stripe separating the black of the median under parts from the gray of the sides and flanks, this white being reduced to a few white spots or streaks; belly broadly black; thighs entirely black or with some narrow white tips; under tail-coverts predominantly black to the base with relatively narrow white tips; white marginal spot on outer rectrices reduced in size; a large black spot on the metacarpal edge of the under wing-coverts. Females more deeply ochreous on the under parts than those of *loretoyacuensis* and with somewhat broader blackish centers to the breast-feathers; black portions of auriculars and malar feathers more extensive, making the sides of the head darker.

RANGE.—Uppermost stretches of the Orinoco and the Cassiquiare near the foot of Mt. Duida, Venezuela.

DESCRIPTION OF TYPE.—Whole head black with a long occipital crest; hind neck and sides of neck with a nearly obsolete whitish line separating the black nape from the back; mantle with uppermost portion dark Cinnamon Brown with an ill-defined blackish shaft-line, the black increasing posteriad to the lower mantle where some of the feathers are almost completely blackish with no more than a brownish tinge on their lateral margins; rump sooty olive; upper tail-coverts black with narrow white tips. Under parts with black of head continued broadly down the middle of the belly to the anal region; sides of breast and flanks dark gray, faintly tinged with brownish; some of both the gray and the black feathers along the line of their meeting have rather inconspicuous whitish streaks or marginal spots largely concealed; under tail coverts medially black with bases sooty, very little paler, and tips white; thighs entirely black. Tail black with white tips on the feathers, broadest on the outermost, almost obsolete on the middle pair; outer margins of the outer pair with a small, rounded, white spot not reaching the shaft (and reaching the margin only on the left one of the pair); all the rectrices with a very narrow pale, grayish white marginal

line, not reaching the tips of the feathers; median pair with a similar line, somewhat broader and white, on their inner margins. Wings externally black; primaries with very narrow whitish outer marginal lines in their middle portions, not reaching bases or tips; secondaries without these marks; tertials with rather broader white margins; upper wing-coverts with white tips, largest on greater series where they extend a little basad along the outer margin, but reduced to dots on the lesser series; longest alula feather with white outer margin; primary-coverts all black; outer scapulars like the greater-coverts; inner scapulars like the upper mantle; inner margins of remiges white except at tips; under wing-coverts largely white but with some dusky tips and with a large patch at the metacarpal margin entirely black. Bill black (in dried skin); feet slaty. Wing, 75 mm.; tail, 62; exposed culmen, 19; culmen from base, 23; tarsus, 26.

REMARKS.—Two males from the Río Cassiquiare are not quite as pronounced as the type and have the irregular whitish marks on the sides of the breast and belly slightly larger, but they are still very different from any of the males of *loreyacuensis* at hand.

Females have the top of the head Burnt Sienna to dark Sanford's Brown, crested; forehead slightly buffy with dusky bases and fine dusky tips, not conspicuous; back Argus Brown x Auburn; rump paler and duller; upper tail-coverts black with white tips. Lores buffy with dusky tips; a narrow superciliary line more deeply colored than the lores but lighter than the crown, with dusky bases inclined to be exposed; auriculars black with whitish shaft-lines or buffy whitish median area across the webs; malar feathering blackish at bases and tips and ochraceous buff across the middle. Chin and throat Ochraceous-Buff with rather broad dusky shaft-stripes on the throat; breast and sides very deep Ochraceous-Buff with broad blackish shaft-stripes, becoming obsolete on the sides; flanks rather duller; belly light Ochraceous-Buff; under tail-coverts deeply colored like the sides but with indistinct dusky cross-bars. Tail about as in the male (type) but the white spots on the outer webs of outer rectrices quite obsolete in one example and larger than in the type in another skin. Wings with primaries and secondaries margined with brown a little duller than the color of the back; tertials margined with ochraceous buff; upper wing-coverts marked as in the male but with buff instead of white; under wing-coverts buffy instead of white and with the black patch on the metacarpal edge somewhat concealed by the ochraceous tips of the feathers; inner margins of remiges slightly buffy. Thighs blackish at base, brown at tip. Maxilla dull brownish black (in dried skins), mandible browner; feet slaty. Wings, 71.25–73 mm.; tail, 57–60; exposed culmen, 17–19; culmen from base, 23–24.5; tarsus, 25.5–26.

A young male is much like the females but is sootier on the wings and has the top of the head with many of the feathers black except at their tips.

Between *fumosus* and *loretoyacuensis* I have not established a direct connection though the differences are such as to leave no doubt of the relationship. It is to the northward of Duida that a multiplicity of variations has developed. In order to understand these to the best advantage, it may be well to start at the mouth of the Orinoco and work up the stream.

I am not able to adopt unreservedly the arrangement proposed by Hellmayr (Field Mus. Nat. Hist. Publ., Zool. Ser., XIII, pt. 3, p. 53, 1924) which assigns all of the Venezuelan birds (except *pulchellus* of the Lake Maracaibo region) to *trinitatis*; yet, with fewer skins than the series examined by Hellmayr, I would hesitate to make a counter proposal were it not for certain new material at hand which helps to explain some of the puzzling factors in Hellmayr's arrangement.

With the establishment of typical *canadensis* in French and Dutch Guiana, the birds from Trinidad are recognizable under the name *trinitatis*. I have only two males from British Guiana, one of which, labeled "Demerara," is not unlike Trinidad males while the other, collected by Alexander and possibly from the eastern portion of the country, is much like true *canadensis*. The difference between the males is small and, without females from various parts of British Guiana, it is impossible to say whether or not both forms occur in this country.

In the Orinoco Delta region and in the former state of Bermúdez (now Anzoátegui and Monagas), the birds are very like the Trinidad examples.

Farther up the Orinoco, at Ciudad Bolívar, Caicara, and the Río San Feliz, there is a prevailing tendency toward lighter coloration than is shown in the delta region. The males are brownish on the back, rather than grayish, but the tone is light, and the lores are decidedly whitish. The under tail-coverts are largely white, sometimes grayish subterminally but without a strongly blackish area in that position such as occurs in *canadensis* and *trinitatis*. The sides and flanks are light gray or even whitish, in reduced contrast to the white area bordering the median black stripe. The females also are pale brown on the back, and are light rufous on the crown, pale ochraceous below, with only moderately heavy streaking on the breast, and with the belly distinctly (though restrictedly) white in the middle. The same style of coloration, possibly a trifle warmer, is exhibited by birds from the Río Surumú, Brazil, an affluent of the Río Cotinga. The region of the Surumú is largely savanna country, I am informed by Messrs. Tate and Carter, who visited the locality, and savanna occurs at places on the top of the

Pacaraima Range and at the headwaters of the Río Caroní in Venezuela and it may extend, at least brokenly, down to the middle stretches of the Orinoco. Consequently it seems entirely possible that a light-colored race may exist in these savannas. Since the Caicara bird has been named *intermedius* by Cherrie, that name would be available for such a pale subspecies, if it can be satisfactorily maintained.

Birds from the state of Falcón are neither typical *trinitatis* nor the Caicara form but probably are nearer the latter though they are slightly darker. The under tail-coverts are without blackish subterminal areas and the lores of the males are rather extensively whitish. Possibly these birds should be considered as intermediate between *trinitatis* and *pulchellus* which latter form inhabits the nearby state of Lara, but, even if so, the similarity to *intermedius* may necessitate their reference to that subspecies. An additional character noted in the two males from the state of Falcón, but not observed in skins from other regions nor in Falcón females, is a small whitish area on the inner webs of the tail-feathers at their extreme base. Its significance is not clear. In any case, material must be examined from the region between Caicara and the state of Falcón to determine the possible continuity of range. Since the region is one of savannas, direct connection is not unlikely. Nevertheless, Hellmayr and Seilern (Arch. Naturg., LXXVIII, A (5), p. 119, 1912) found three males from San Esteban, Carabobo, to be more grayish, less rufous, above than others from British Guiana, Trinidad, and the Río Branco, Brazil, being like skins from the Caura region and San Fernando de Apure!

On the Río Caura, a different type of coloration is encountered which is not that of Caicara and Ciudad Bolívar although the Caura empties into the Orinoco between these two places. Judging by the darker hues, the Caura birds are inhabitants more of forests than savannas and, from available accounts, the Caura is marked by this type of habitat. Some relationship to the forest-inhabiting *fumosus* is, therefore, to be expected.

Four males from as many localities (Río Mato, Suapure, Maripa, and La Unión) all have the white stripes bordering the median black area of the under parts virtually obsolete, being dull and grayish and not distinguishable as sharply-defined white; the lower belly is quite sooty, not white. The metacarpal border of the under wing-coverts is broadly black in the Río Mato male, with white tips in the Maripa skin, intermediate in the other two; the under tail-coverts have blackish bases and relatively narrow white tips; the male from La Unión has the lores

quite black, though the three other males have much white in this region. All these tendencies are in the direction of *fumosus*. The back is rather plain, without the heavy streaks of *fumosus* but of a darker tone than in *intermedius*. An additional character of doubtful significance is the decided reduction of the white spot on the lateral margins of the outer pair of rectrices. Instead of the customary broad patch reaching from the shaft to the margin, there is only a narrow marginal streak, rarely supplemented by a small oval spot in the middle of the web. A young male has the patch of exceptionally large size, connecting on the left rectrix with the white at the tip of the feather. In the Caura females the patch is of the regular size or but slightly reduced, and, in addition, the general color of both upper and under parts is as near to that of female *intermedius* as to that of *fumosus*, being intermediate between the two, as in the males. The general impression left by the Caura birds of both sexes is that of intermediates between *intermedius* and *fumosus*, not definitely referable to either.

In the neighborhood of the upper Orinoco, above Caicara, from Maipures to the falls of the Atures at Ayacucho, another definite change of color and pattern is found which bears little relation to the Caura series. The males from this region are even darker and more rufous brown on the back than the Caura males with the added features of rather prominent dusky streaks and an evident, though very small, concealed patch of white on the mantle. The white patch on the outer margins of the outer rectrices is not reduced in size but the lores are noticeably whitish. However, the under parts have not lost any of the broad white areas but rather have this white more decidedly in evidence than usual and the lower belly is white, showing no approach toward *fumosus* in these respects. I have no females from this part of the Orinoco, but a young male from the "Upper Orinoco" (judging by the collector's dates, not far from Maipures) is very like the young male from the Caura (Maripa) and, like it, has unusually extensive white on the outer margins of the outer rectrices, but is a little duller on the mantle. [Curiously enough, a young male of *intermedius* from the Rio Surumú, Brazil, and one from Ciudad Bolívar, Venezuela, also have the white spots of tip and outer margin of the outer rectrices continuous, with a small subterminal spot of dusky on the outer web, and a young female of *trinitatis* from Las Barrancas, Río Orinoco, has the same continuity without any dusky spot, as in *pulchellus*. An occasional skin of *pulchellus* shows a subterminal dusky spot and one male from La Cienga, Santa Marta, has the marginal patch connected with the terminal spot only

by a very narrow line on the outer margin of the outer web.] There is a tendency toward the development of white not only on the lores, as mentioned, but also on the forehead and superciliary region (as well as in the malar region where it appears frequently in other forms). The under tail-coverts are grayish as often as sooty and are quite broadly tipped with white which conceals the darker basal portions. The nearest affinity, in several of these respects, is *pulchellus* which occurs southeast of Lake Maracaibo though on the far side of the cordillera which separates the drainage of this lake from the rivers flowing to the upper Orinoco.

A single male from San Fernando de Atabapo, between Ayacucho and Mt. Duida, is more like *fumosus* than are the Ayacucho birds, but it still has the white on the sides of breast and belly and the streaked upper parts with more of brown than of black though the brown is grayer and less rufous than in Ayacucho males. Resemblance is apparent to some *loretoyacuensis*, which probably is due not to racial consanguinity but rather to a parallelism reached in the transition from *fumosus* to *pulchellus* or *intermedius*.

The only other skin which needs special mention is a male from Caracahy, on the middle stretches of the Rio Branco, Brazil. This bird is plain brown on the mantle, of a darker hue than that of *intermedius* from the affluents of the upper Branco; in other respects it resembles *loretoyacuensis*. Since it comes from a locality in the region where the ranges of these birds must meet, it may be considered as intermediate between them.

In spite of the apparent regularity of the variations on the Caura and at Ayacucho and Maipures, and the impossibility of referring the respective series to one form or another, I hesitate to name new forms from these two regions. Obviously *fumosus*, as an inhabitant of forested areas, finds its way across the Pacaraima Mts. to the upper Caura which is forested, and extends down that stream in somewhat modified form, affected, probably, by some contact with the paler *intermedius* of the savannas which is more prevalent to the east and northward.

On the other hand, descending the Orinoco, an earlier contact occurs with savanna-covered regions, and a different modifying factor may exist in *pulchellus* some distance to the northwestward, resulting, in any event, in a somewhat different combination of characters as outlined above. Until more material is available from other localities I can do no more than suggest the lines of possible relationship.

SPECIMENS EXAMINED

S. c. canadensis.—FRENCH GUIANA: Cayenne, 2 ♂, 2 ♀; Approuague, 1 ♀. DUTCH GUIANA: Paramaribo, 1 ♂, 1 ♀.

S. c. trinitatis.—TRINIDAD: Moruga, 2 ♂, 1 ♀; (no other locality), 1 ♂; San Fernando, 1 ♀; Monos Island, 1 ♂. BRITISH GUIANA: Demerara, 1 ♂; (no other locality), 1 ♂. VENEZUELA: Sacupana, 1 ♂; Las Barrancas, 1 ♂, 1 ♀; Guanaguana, 1 ♂, 1 ♀.

S. c. intermedius.—VENEZUELA: Caicara, 3 ♂, 2 ♀ (incl. type); Ciudad Bolívar, 4 ♂, 1 ♀, 1 "♀" (= ♂); Tucacas, Est. Falcón, 2 ♂, 4 ♀. BRAZIL: Rio Surumú, Frechal, 3 ♂, 3 ♀.

S. c. pulchellus.—VENEZUELA: Baraquismeto, 2 ♂, 2 ♀; El Cuji, 2 ♂, 1 ♀; (no other locality), 1 ♂. COLOMBIA: Santa Marta, 1 ♂; La Cienaga, 1 ♂, 1 ♀; Bonda, 3 ♂; Algodonal, Río Magdalena, 1 ♂; Banco, 1 ♂; La Playa, near Baranquilla, 3 ♂, 3 ♀; Turbaco, 1 ♂; Calamar, 1 ♀.

S. s. fumosus.—VENEZUELA: Lalaja, Río Orinoco, 1 ♂ (type); Río Cassiquiare, opposite El Merey, 3 ♂, 2 ♀.

S. c. fumosus x *intermedius*.—VENEZUELA: Río Mato, 1 ♂, 1 ♀; Suapure, 1 ♂; Maripa, 2 ♂, 2 ♀; La Unión, 1 ♂.

S. c. fumosus x *intermedius* x *pulchellus*.—VENEZUELA: Maipures, 1 ♂; "Upper Orinoco," 1 ♂; Ayacucho, 4 ♂; San Fernando de Atabapo, 1 ♂.

S. c. loretoyacuensis.—PERÚ: "Upper Ucayali," 1 ♂. BRAZIL: Tefé, 1 ♂, 1 ♀; Rio Negro, Muirapinima, 2 ♂, 2 ♀; Yavanari, 1 ♂; Tabocal, 1 ♂; Carvoeira, 1 ♂; Rio Branco, Nova Vida, 1 ♂, 1 ♀.

S. c. loretoyacuensis x *intermedius*.—BRAZIL: Rio Branco, Caracaray, 1 ♂.

***Sakesphorus bernardi piurae* (Chapman)**

Thamnophilus bernardi piurae CHAPMAN, 1923 (August 28), Amer. Mus. Novitates, No. 86, p. 3—Samate, 250 feet, Prov. Piura, Perú; ♂; Amer. Mus. Nat. Hist.

I can add little to the published accounts of this bird since I have no material not already reported upon. The female specimen from Callacate collected by Stolzmann still remains the only known example from the Marañón drainage where it must be rather rare. I have no doubt that Chapman and Hellmayr are correct in assigning the specimen (which I have not seen) to *piurae*. It probably reached the region of the Río Chota by way of the Porculla Pass or the Huancabamba Pass but apparently has not extended its range very far on the eastern side of the divide. Two of the males from the type locality and one from Palambra are grayer on the back than the type and one other topotype and thus approach true *bernardi*.

***Sakesphorus bernardi cajamarcae* (Hellmayr)**

Hypolophus bernardi cajamarcae HELLMAYR, 1917 (September), Verh. Orn. Ges. Bayern, XIII (2), p. 188—Tembladera, n. Perú; ♂; Munich Mus.

Thamnophilus bernardi baroni HARTERT AND GOODSON, 1917 (December), Novit.

Zool., XXIV, No. 3, p. 498—Yonan River, northeast of Trujillo, Perú; ♂; Rothschild Coll., Amer. Mus. Nat. Hist.

Recorded from Guadalupe, Paucal, Trujillo, Río Yonan, Menocucho and the localities given below.

SPECIMENS EXAMINED

S. b. bernardi.—ECUADOR: Guayaquil, 3 ♂, 2 ♀; Chongocito, 2 ♂, 3 ♀; Manta, 3 ♂, 1 ♀; Manaví, 1 ♂, 1 ♀; Daule, 2 ♂; Santa Elena, 1 ♀; Chongon Hills, 1 ♀; Isla Puna, 4 ♂, 3 ♀.

S. b. piurae.—ECUADOR: Lunamá, 1 ♂; Santa Rosa, 2 ♂, 2 ♀. PERÚ: Samate, 4 ♂ (incl. type), 4 ♀; Palambra, 4 ♂, 3 ♀; Paletillas, 2 ♂, 1 ♀; Milagros, 1 ♂, 1 ♀; Sullana, 1 ♂, 1 ♀; Chilaco, 1 ♂, 2 ♀; Tumbes, 1 ♂, 1 ♀.

S. b. cajamarcae.—PERÚ: Viru, 6 ♂, 4 ♀; Trujillo, 1 ♀.

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A NEW LONGHORNED BELLY RIVER CERATOPSIAN

BY BARNUM BROWN

Among the specimens collected by the American Museum expedition to the Red Deer River, Alberta, in 1913, is a splendid ceratopsian skull previously identified as *Ceratops*, but which Dr. Richard Swann Lull points out conforms in general characters to the Belly River genus *Chasmosaurus*.

The genus *Chasmosaurus* Lambe, Doctor Lull diagnoses for the most part as follows: Skull long and low; muzzle generally long with small rostral; face short with the three horns approximated; crest very long



Fig. 1. *Chasmosaurus karseni*. Type. A. M. N. H. No. 5401, skull, right side. One-fifteenth natural size.

and comparatively flat, with long, triangular squamosals extending nearly to the posterior margin of the crest; median element of the crest (dermo-supraoccipital?), a straight longitudinal bar, convex above and flatly concave below which separates the two large fenestrae. At the rear this bar bifurcates, meeting the squamosals and sending a narrow process forward on either side to meet, in an overlapping suture, one extending backward from the anterior part of the central element. These form the outer border of the fenestrae, thus separating it from the squamosal;

epoccipitals, about nine in number, border the squamosal; a variable number are present on the posterior margin of the central element, of which a large pair at the outer corners of the crest are the most constant in position and occurrence; crest without vascular impressions; nasal horn shorter than in the contemporaries, *Centrosaurus* or *Styracosaurus*, rather stocky and of variable length; brow horns range from incipient mere roughenings above the orbit to the elongated ones of the present species.

It gives me great pleasure to name this species after Mr. Peter C. Kaisen, my friend and able assistant during many expeditions, skilled preparator, and a member of the American Museum staff for more than a third of a century.



Fig. 2. *Chasmosaurus kaiseni*. Type. A. M. N. H. No. 5401, skull, left side. One-fifteenth natural size.

Chasmosaurus kaiseni, new species

TYPE.—A. M. N. H. No. 5401. A nearly perfect skull, without lower jaws. Collected by Barnum Brown and P. C. Kaisen.

HORIZON.—Belly River Cretaceous.

LOCALITY.—Fourteen miles below Steepleville, on the Red Deer River, Alberta.

SPECIFIC CHARACTERS.—Muzzle very long, with relatively small rostrum; nasal horn prominent, but not long, somewhat rugose; brow horns large and much longer than any described species of this genus, resembling those of the Judith River species *Ceratops montanus* more nearly than any Belly River form. They rise well over the anterior half of the orbit, flare outward and at the same time bend sharply forward and then curve upward; they are deeply impressed with vascular grooves. The orbit is large and broadly elliptical with the long axis approximately vertical. The squamosal is broad at the anterior end with a pointed epoccipital at the antero-external

angle. The jugal notch is deep and parallel-sided. The jugal is long, sloping outward and backward, bearing a long, pointed epijugal suggestive of *Peniaceratops*. The central bar of the crest in mid-section is trihedral and the rear of the crest is but slightly emarginate.



Fig. 3. *Chasmosaurus kaiseni*. Type. A. M. N. H. No. 5401, skull, front view. One-fifteenth natural size.

MEASUREMENTS

Greatest length, from tip of rostrum to rear of crest at outer edge.	1520 mm.
Width of crest, across rear end of squamosals.	820 mm.
Length from tip of rostrum to posterior end of nasal horn. . .	463 mm.
Length from tip of rostrum to posterior end of jugal.	724 mm.
Length from tip of rostrum to anterior edge of orbit.	560 mm.
Length from occipital condyle to middle of crest.	710 mm.
Length of orbit.	102 mm.
Breadth of orbit.	62 mm.
Height of brow horn from rim of orbit.	370 mm.

AMERICAN MUSEUM NOVITATES

Number 670

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Nov. 3, 1933

56.81.4 C: 14.71.4

A SKULL WITH JAWS OF *CROCODYLUS SIVALENSIS* LYDEKKER

BY CHARLES C. MOOK¹

INTRODUCTION

In the series of fossil vertebrates collected by Mr. Barnum Brown in India is a well-preserved skull of a short-snouted crocodile, with jaws, from the Upper Siwalik Beds, fifteen miles east of Chandigarh, India. Examination of the characters of this skull reveals considerable similarity to *Crocodylus pakistris* Lesson, to *C. sivalensis* Lydekker, and to *C. palaeindicus* Falconer and Cautley.

Certain critical anatomical structures that serve to distinguish these three closely related species from each other are lacking in the present specimen, but enough structures are preserved to indicate its reference to *C. palaeindicus*, at least provisionally.

The specimen is sufficiently well preserved to deserve description.

SPECIMEN.—Amer. Mus. Nat. Hist. No. 1915. Skull with outline essentially complete, some local portions missing. Jaws practically complete. A few teeth in position in both skull and jaws.

TYPE LOCALITY AND LEVEL.—About fifteen miles east of Chandigarh, India. In variegated beds of the Upper Siwalik Formation, immediately below the Boulder Conglomerate.

GENERAL FORM OF SKULL

The skull is broad and short. The breadth of the snout at its base is about three-fourths of its length. The anterior portion of the snout, surrounding the external narial aperture, is particularly broad. The length of the snout from the lateral notches at the premaxillo-maxillary sutures to the tip, is about five-ninths of the breadth of the snout at the expansion immediately anterior to these notches. The notches themselves are sharp and clean-cut but do not extend very far inward from the normal lateral margins.

Posterior to the notches the borders expand to the level of the fifth maxillary teeth, then contract to the level of the eighth maxillary teeth, then expand gradually and more or less regularly to the region of the quadratojuggals.

¹Contributions to the Osteology, Affinities, and Distribution of the Crocodilia. No. 25.



Fig. 1. *Crocodilus sivalensis* Lydekker. Skull. Amer. Mus. No. 1915. About one-fourth natural size. Superior view.

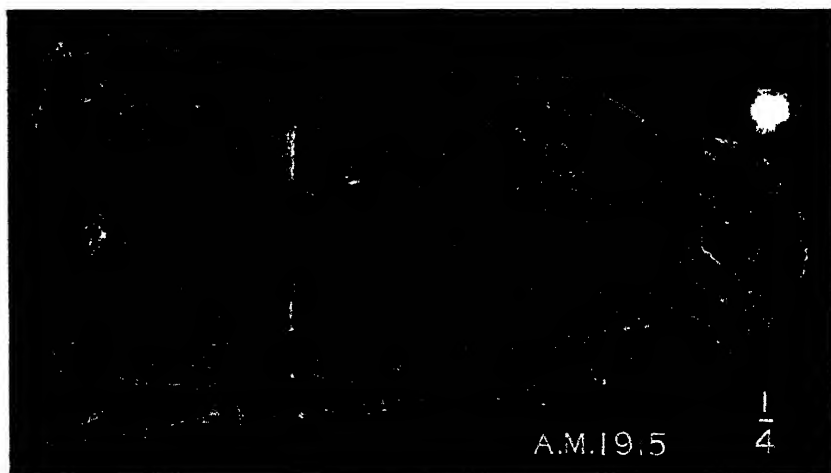


Fig. 2. *Crocodilus sivalensis* Lydekker. Skull. Amer. Mus. No. 1915. About one-fourth natural size. Inferior view.

Viewed from the side the upper profile appears to be slightly convex, but this region is not completely preserved. The lower profile exhibits a pronounced degree of festooning. Starting at the tip, the border descends slightly, in a straight line, to a point half-way between the anterior and posterior borders of the narial aperture, then bends sharply upward to form the anterior border of the premaxillary notch. From the junction of the premaxillo-maxillary suture and the external border, the inferior border bends sharply downward and backward to the level of the fifth maxillary teeth. The notch is much more pronounced in the lateral than in the superior view. From the fifth maxillary tooth the inferior border bends sharply upward and backward to the level of the eighth maxillary tooth, then backward and downward to the level of the tenth maxillary tooth, then backward and slightly upward to the level of the lateral temporal fenestra, then downward and backward to the posterior border of the quadrates.

The cranial table is relatively long in proportion to its breadth. Its lateral borders appear to converge rather gently forward. The posterior border of the table is extremely irregular, projecting backward at the postero-external angles and at the mid-line, and curving forward immediately behind the supratemporal fenestrae. The spaces between the supratemporal fenestrae and the posterior border are broad. The interfenestral plate is narrow, but the interorbital plate is of moderate width.

THE CAVITIES OF THE SKULL

The SUPRATEMPORAL FENESTRAE are small and are close together. They are ovoid in form, the broader portion being posterior to the narrow portion. The maximum breadth is about two-thirds of the length. The axes of maximum length converge slightly forward.

Each fenestra is farther from the external border than it is from the other fenestra, but is nearer the external border than the posterior border.

The LATERAL TEMPORAL FENESTRAE have imperfectly preserved borders on each side, so their outline cannot be positively determined. They do not appear to be particularly distinctive.

The ORBITS are large and subcircular in outline, their breadth being approximately equal to their length. They face upward and slightly outward, as in most crocodilians, but the lateral component is somewhat greater than is usual in true crocodiles. The latter character does not appear to be accentuated by crushing. They extend forward about to the level of the twelfth maxillary teeth.

The external narial aperture is very distinctive. Its borders are not complete, but enough of them are present to enable the form and size of the aperture to be made out with a fair degree of accuracy. The size

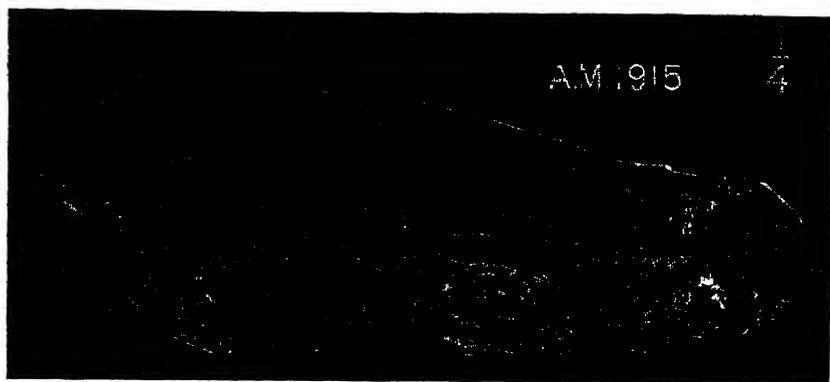


Fig. 3. *Crocodilus sivalensis* Lydekker. Skull and Jaws. Amer. Mus. No. 1915. About one-fourth natural size. Lateral view, right side.



Fig. 4. *Crocodilus sivalensis* Lydekker. Skull. Amer. Mus. No. 1915. About one-fourth natural size. Posterior view.

of the aperture is enormous. It is relatively far larger than in any known crocodilians except the three Indian species—*C. palustris*, *C. sivalensis*, and *C. palaeindicus*. Its breadth is about five-sixths of its length. Its breadth is also about two-thirds of the breadth of the snout across the

notches. The aperture is quite far back in position; about three-fifths of its length is anterior to the level of the notches and about two-fifths is posterior to this level. The space between the aperture and the anterior end of the snout is about three-fifths as long, measured along the mid-line, as the antero-posterior diameter of the aperture.

The **PREMAXILLARY FORAMEN**, on the palate, has the borders incompletely preserved, but enough of them is preserved to indicate the character of the opening. It is oval in outline, its antero-posterior diameter being slightly greater than its transverse one. The level of the posterior border of the foramen coincides with the level of the posterior edges of the fifth premaxillary teeth.

The **PALATINE FENESTRAE** have very incomplete borders. The internal borders are lacking on both sides. The external borders are partially preserved on each side. The anterior border of the left fenestra is preserved, also most of the posterior border of the right one. The characters of the fenestrae can be determined with a fair degree of accuracy. They are somewhat broader in proportion to their length than in most species, the breadth being about two-thirds of the length. The anterior tips of these fenestrae are at the level of the anterior ends of the tenth maxillary teeth.

The region of the **INTERNAL NARIAL APERTURE** is not preserved.

THE BONES OF THE SKULL

⁴Some of the bones of the skull are missing; others are incomplete, or their sutural boundaries are obscure. Other bones are well preserved, have clearly outlined boundaries, and are distinctive in form. These are described in some detail.

THE PREMAXILLARIES.—The premaxillary region is especially characteristic, being very broad and short. The sutures on the superior surface are obscure, but it appears unlikely that the posterior processes extended very far back. The region anterior to the narial aperture is unusually large.

On the palate, boundaries can be determined more accurately. The maximum length is about three-fourths the maximum breadth. The alveoli are well-preserved except the first and the second. The characters of the teeth may be judged from the alveoli to a certain extent. The first premaxillary teeth, as determined from the right alveolus, were very small; they were situated close to the mid-line and very close to the anterior border. They bit between and anterior to the first mandibular teeth. The second alveolus is preserved on the right side only.

It is very small and is rather obscure. It is separated widely from the first alveolus, but is very close to the third one. The third alveolus is complete on both sides, and on the right side contains a broken tooth. This alveolus is much larger than either the first or the second. Its external border is in line with the first and second, but its internal border extends considerably farther inward and is supported by a strong buttress. It is very close to the second and is moderately far from the fourth. The fourth alveolus is complete on both sides, the right one containing a broken tooth. It is by far the largest in the premaxillary series, equaling in size the fifth maxillary. The tooth has about twice the diameter of the third and four or five times that of the second. It is equally spaced from the third and fifth. Its internal border extends much farther inward than any of the other premaxillary teeth and is supported by a very stout buttress. The fifth alveoli are complete on both sides. They are of moderate size, being slightly smaller than the third and much larger than the first or second. They are rather close to the fourth, but do not have strong buttresses as do the latter.

Partly posterior to the first alveoli and partly posterior to the spaces between the first and second alveoli are two large pits that received the first lower teeth. These pits are broad and deep, but they do not penetrate to the superior surface of the skull. A pair of smaller pits is situated between and slightly internal to the third and fourth teeth. These pits are bounded anteriorly and posteriorly by the buttresses that support the third and fourth teeth. The pits extend little, if at all, below the level of the palatal surface of the skull. The order in size of the premaxillary teeth, from the smallest to the largest, is: 2d, 1st, 5th, 3d, 4th. The premaxillo-maxillary suture, on the palate, extends directly inward, on each side, from the notch for about one-third of the distance from the tooth-row to the midline, then bends backward and inward for a similar distance, then extends almost directly transverse for a slightly shorter distance, then inward and forward to the mid-line. The posterior point in the suture is at the level of the second maxillary teeth.

The MAXILLARIES are broad on the superior surface of the skull; they are characterized by rough pitting, and by nodose elevations. The sutural boundaries are for the most part not very clear, except to indicate that these bones extended back to a level slightly anterior to the centers of the orbits.

The palatal portions of the maxillaries are well preserved. The suture along the mid-line is unusually short, being only seventeen per cent. of the length of the skull from condyle to tip of snout. In most

crocodilians, even the short-snouted species, this percentage is over twenty-five. The posterior end of the maxillaries, along the mid-line, is at the level of the seventh maxillary teeth.

Each maxillary contained fourteen teeth. Only one of these, the tenth of the right side, is completely preserved. It is comparatively short-crowned and long-rooted; its antero-posterior diameter is considerably greater than its transverse, and the rounded apex of the crown is nearer the internal than the external margin. No blade appears anywhere on the tooth, its sides being rounded in every direction. Other teeth that are partly preserved give evidence of a short, stout type of dentition. The first six teeth on each side are lodged in a strong ridge, which extends far below the level of the palatal surface, especially in the vicinity of the fourth and fifth teeth. This character may have been accentuated somewhat by crushing.

The first maxillary teeth are small; from the first the teeth increase regularly in size back to the fifth, which is the largest in the series. The sixth approximately equaled the fourth in size. Posterior to the sixth the teeth were all of moderate size, the thirteenth and fourteenth being somewhat smaller than the rest. The first four maxillary teeth are close together. Posterior to the fourth the teeth are all moderately spaced from each other, and all have separate alveoli, possibly excepting the thirteenth and fourteenth.

The NASALS, PREFRONTALS, and LACHRYMALS are not sufficiently well preserved to warrant detailed description, except that the lachrymals were apparently large.

The FRONTAL is not especially distinctive, except that the inter-orbital plate is of moderate width and is concave upward, and that the bone is apparently excluded from the borders of the supratemporal fenestrae.

The PARIETAL is extended backward into a prominent process, excluding the supraoccipital from the superior surface of the skull.

The SQUAMOSALS also are extended backward at the postero-external corners of the cranial table.

The PALATINES, PTERYGOID, AND BASISPHENOID are not preserved.

The occipital condyle of the BASIOCCIPITAL is bent sharply downward.

The POSTORBITAL, ECTOPTERYGOID, SUPRAOCCIPITAL, EXOCCIPITALS, JUGALS, QUADRATOJUGALS, AND QUADRATES are not distinctive.

LOWER JAWS

The lower jaws are better preserved than the skull, being essentially complete.

The jaws are narrow at the tip; their external borders diverge rapidly to the level of the fourth teeth. From this point backward the divergence of the two rami is slight when considered in connection with the broad, short skull. The amount of anterior and lateral overhang of the upper jaws over the lower is considerable.

The symphysis is short, extending back only to the level of the posterior borders of the fourth teeth. The degree of participation of the splenial in the symphysis is not clear, but evidently it was slight. The external mandibular foramen is slight, its length being only about one-tenth of the total length of the skull. The axis of maximum length of the fenestra is oblique to the long axis of the ramus, bending downward slightly in the anterior direction.

The vertical festooning of the superior border of each ramus is considerable, but not excessive; there are pronounced elevations at the levels of the first, third, and fourth, and tenth and eleventh teeth, with valleys between them.

The first tooth is preserved on the left side; it is large and prominent. The two first teeth are rather widely separated at the median line. The second alveoli indicate much smaller second teeth; they are spaced rather far from the first. The third alveoli are very small, being about the smallest in the dental series. They are widely spaced from the second alveoli, and are very close to the large fourth alveoli, being located on the same buttresses as the latter. The fourth alveoli are by far the largest in the series. They are situated on prominent buttress-like elevations, along with the third and fifth. They are located very close to the small third and fifth alveoli. Back of the fourth are four small alveoli, spaced moderately far apart from each other (the first of these, being the fifth in the series, is close to the large fourth, as noted above). Posterior to each eighth alveolus is a broad space, which is succeeded by three teeth close together, the ninth, tenth, and eleventh. Of these the ninth and eleventh are of moderate size, while the tenth is large, being only slightly smaller than the first. Posterior to the eleventh are four moderate-sized alveoli that are moderately spaced from each other.

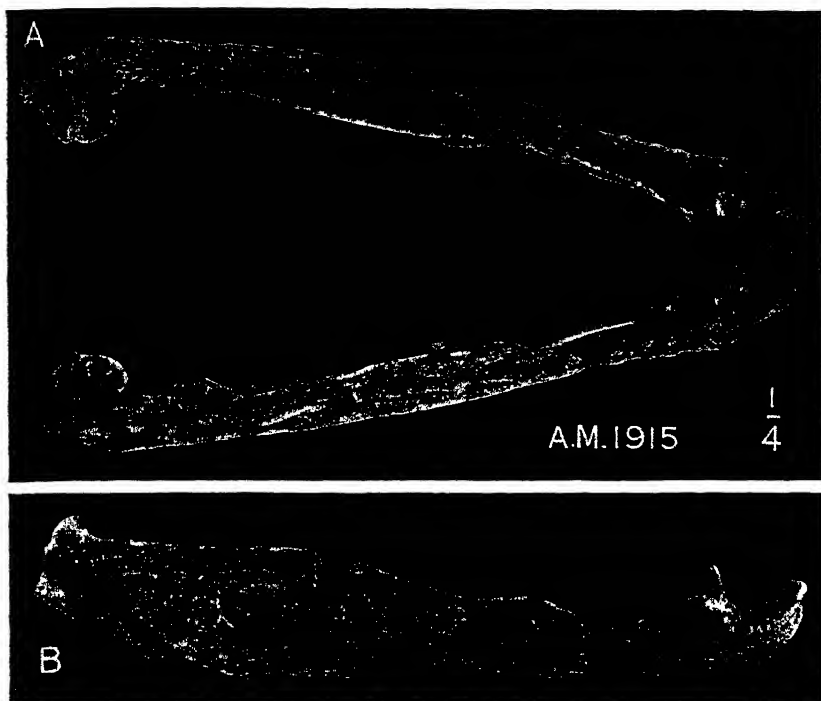


FIG. 5. *Crocodilus sivalensis* Lydekker. Jaws. Amer. Mus. No. 1915. About one-fourth natural size. A. Superior view. B. Lateral view, right side.

MEASUREMENTS

	mm.
Length of skull, occipital condyle to tips of snout.....	403
Length of skull, from tips of quadrate to tip of snout.....	426
Breadth of skull across quadratojugals.....	224 est.
Breadth of skull at anterior ends of orbits.....	197½
Breadth of skull at fifth maxillary teeth.....	173
Breadth of skull at premaxillo-maxillary notches.....	110
Breadth of premaxillaries, maximum.....	119
Breadth of cranial table, posterior end.....	127 est.
Breadth of interorbital plate.....	16
Breadth of interfenestral plate of parietal.....	42
Length of supratemporal fenestrae.....	33
Breadth of supratemporal fenestrae.....	26
Length of external narial aperture.....	57 est.
Breadth of external narial aperture.....	72
Mid-line suture on palate between the two maxillaries.....	78

MEASUREMENTS (*Continued*)

	mm.
Length of mandible, median.....	440
Breadth of mandible, maximum.....	224
Breadth of mandible across the fourth teeth.....	106
Length of symphysis.....	64

CONCLUSIONS

The characters listed above agree rather closely with those of the "mugger" (*Crocodilus palustris* Lesson), and the specimen supports Lydekker's view that *C. sivalensis* is closely related, if not directly ancestral, to *C. palustris*.

AMERICAN MUSEUM NOVITATES

Number 671

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Nov. 4, 1933

56.81.4:14.71

A CROCODILIAN SKELETON FROM THE MORRISON FORMATION AT CANYON CITY, COLORADO

BY CHARLES C. MOOK¹

INTRODUCTION

In the collection of fossil Crocodilia in the United States National Museum is a series of vertebrae with an ilium, and some scutes, that deserve notice. I am indebted to Mr. C. W. Gilmore, Curator of Vertebrate Paleontology at the National Museum, for permission to describe this material.

The specimen consists of fourteen presacral, two sacral, and three caudal vertebrae, the left ilium, three well-preserved scutes, half of another scute, and fragmentary portions of other scutes. It constitutes No. 5836 of the National Museum Collections. (Original Number 1683.) It was collected by M. P. Felch in 1884 from a level in the Morrison Formation near Canyon City, Colorado, slightly above the principal bone level.

The preservation is peculiar. The remains are imbedded in a block of white sandstone. The centra of all the vertebrae are exposed, also the ventral surfaces of the transverse processes in the caudals, the sacrals, and the last four presacrals. The next ten presacrals have the left sides of the neural arches and ventral surfaces of the transverse processes exposed, but the right sides are still imbedded in the matrix, if they are present.

In the region including the seventh to the fifth presacrals, the column has been split vertically immediately to the right of the centra. This exposes the centra on one block and the impressions of the centra with fragments of bone on the other. The spines have been split vertically, so portions of them appear in each block. The separation has been slightly different in the fourteenth presacral, so that the section of the neural canal is not exposed.

On either side above the spines, sections of scutes appear, apparently in their original positions, indicating the relations of the scutes to the vertebral column. On the right side three complete scutes and portions

¹Contributions to the Osteology, Affinities, and Distribution of the Crocodilia, No. 26.

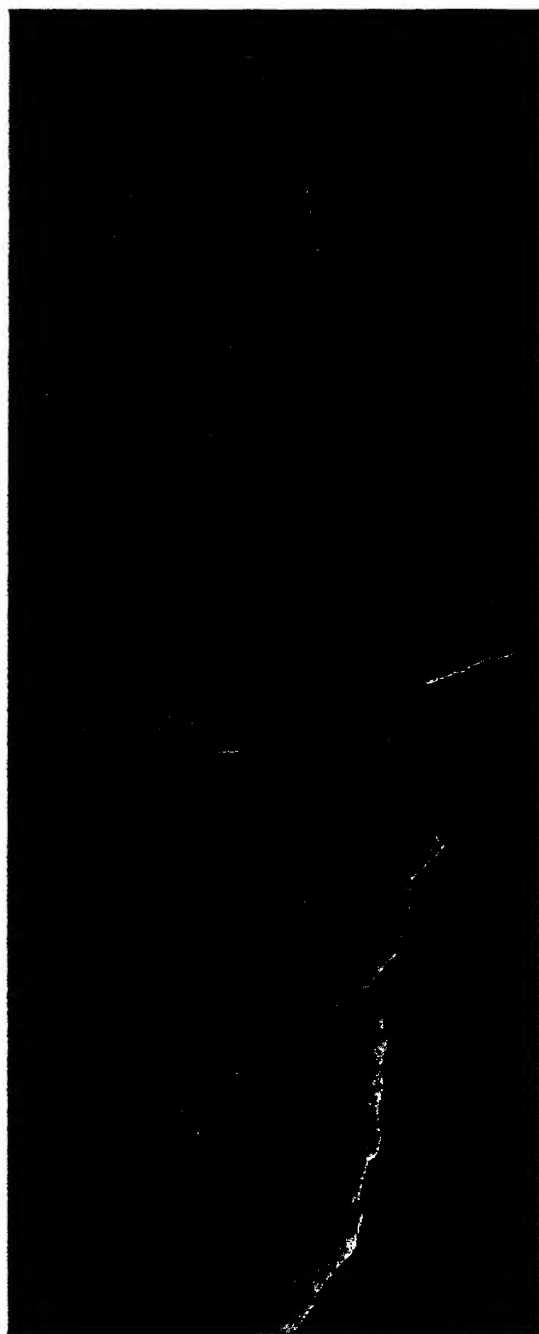


Fig. 1. *Goniopholis* sp. Skeleton. U. S. Nat. Mus. No. 5836. Natural size. Inferior view.

of two others are exposed on the surface, showing their dorsal characters. The inferior and external aspects of the left ilium are exposed.

The identification of the specimen is not certain. It may be regarded provisionally as a young individual of *Goniopholis* (*Amphicotylus*) *lucasii* Cope.

CHARACTERS OF PRESACRAL VERTEBRAE

The seventeenth presacral vertebra is poorly preserved and its characters cannot be made out. The sixteenth is preserved in section only, and the characters that may be observed are not distinctive. The fifteenth presacral has a long, inclined spine, with a very small antero-posterior diameter.

The fourteenth presacral has a sharp central keel, and the spine is broad antero-posteriorly. The transverse process is of moderate length and is slender. The capitular facet is situated immediately above the level of the upper border of the centrum.

The thirteenth presacral has the centrum rather sharply rounded ventrally, not keeled as in the fifteenth, and not broadly rounded, as in the more posterior vertebrae. The capitular facet is on the transverse process, slightly nearer to the extremity of the latter than to the superior surface of the centrum. The proximal portion of the process, below the capitular facet, is broad; the distal portion, external to the capitular facet, is slender. The spine is broad antero-posteriorly and is semicircular at the summit in the same direction.

The twelfth presacral has a slightly longer centrum than the thirteenth. This centrum is rounded inferiorly. The capitular facet is nearer the tip of the transverse process than to the upper border of the centrum. The height of the spine about equals its length. The tip of the spine is semicircular antero-posteriorly.

In the eleventh presacral the centrum is somewhat damaged. The capitular facet is slightly nearer the tip of the transverse process than is the corresponding facet in the twelfth presacral. The antero-posterior diameter, across the extremities of the zygapophysial processes, is greater in this vertebra than in any other member of the series. The spine is similar to that of the twelfth presacral.

The centrum of the tenth presacral is broadly rounded. The capitular facet is nearer to the tip of the transverse process than in the eleventh presacral, but is still a distinct facet. The spine is similar to those of the eleventh and twelfth presacrals.

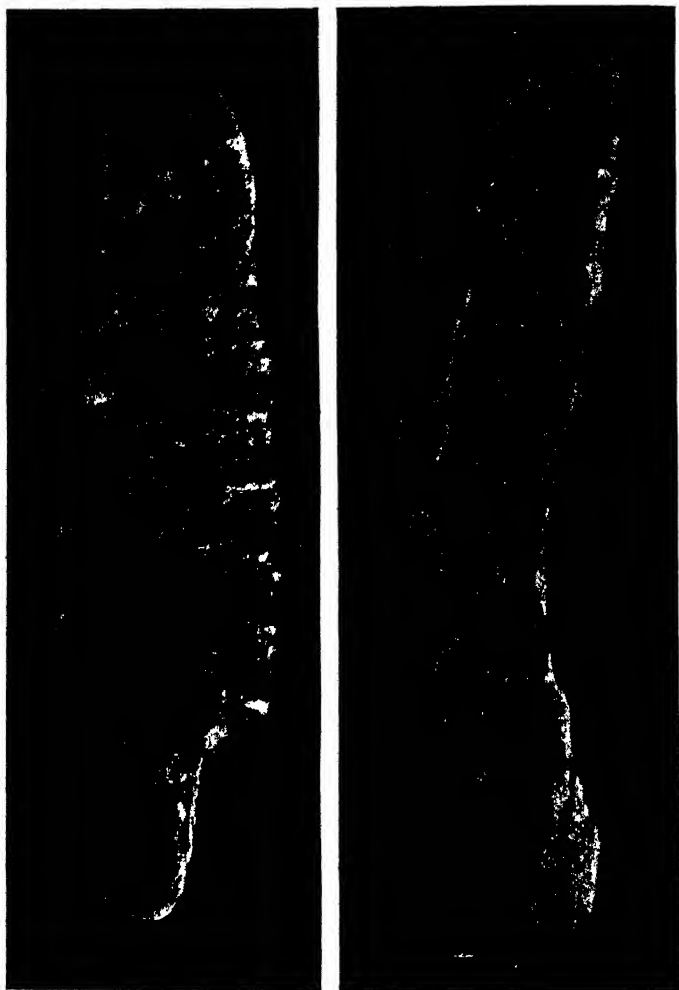


Fig. 2. *Goniopholis* sp. Vertebrae and scutes. U. S. Nat. Mus. No. 5836. Natural size. A, dorsal vertebrae. B, reverse of same block.

The centrum of the ninth presacral is slightly broader than that of the tenth presacral. The capitular facets are very near the tubercular facets. The transverse process in this vertebra is the longest in the series. The spine is similar to that of the preceding presacrals.

The centrum is not preserved in the eighth presacral. The capitular and tubercular facets cannot be discerned clearly. They are evidently very close together on the extremity of the broad transverse process. The spine is relatively high in comparison with the slight antero-posterior diameter.

The seventh presacral is poorly preserved. It is clear, however, that its centrum was of moderate length, and that its transverse processes were not very long, and were rather slender. The tubercular and



Fig. 3. *Goniopholis* sp. Vertebrae and left ilium. U. S. Nat. Mus. No. 5336. Natural size. Lateral view of vertebrae. External view of ilium.

capitular facets were apparently not separated. This suggests that there may have been a single-headed rib attached to it. On the other hand, the vertebra may have been a lumbar and have had no rib. The latter interpretation is unlikely, however, as it would involve an unusually long lumbar region. Usually there are one or two single-headed ribs between the typical two-headed dorsal ribs and the lumbar region. The spine is not visible.

Presacral six has a centrum of moderate length and a short, rectangular transverse process. It is not well exposed.

Presacral five is poorly preserved. So far as visible it resembles presacral six. A transverse section of the spine and neural cavity shows the spine to be low and the cavity circular in cross-section.

The fourth presacral is well preserved, but only the ventral aspect is exposed. The centrum is long and is broadly rounded ventrally. The transverse processes are of moderate length and are slender. The vertebra has the characters of a true lumbar.

Presacral three is almost identical in characters with presacral four.

The centrum of presacral two is not well preserved. The transverse processes are short and slender; they are directed slightly backward at the tips.

The first presacral has a broad centrum. Its transverse processes are very short and very slender. They are much smaller than those of the second presacral.

The individual was evidently young, and in most of the dorsal vertebrae present the neural arch has separated slightly from the centrum along the sutural connection between these elements, allowing sandy matrix to fill in between them. In the lumbar region there is no such separation.

CHARACTERS OF THE SACRAL VERTEBRAE

The first sacral has a centrum that is both long and broad. It has broad sutural connections with the bases of the sacral ribs. The ribs themselves are much longer than the transverse processes of the last lumbar. The ribs are slender antero-posteriorly, except at their bases. They may be expanded vertically, but their entire vertical extent is not visible. The left rib is joined to the ilium of that side, and its contact is largely covered by matrix. The distal end of the right rib is free, and exhibits the surface for articulation with the ilium as an oblique, triangular, roughened area.

The centrum of the second sacral is slightly shorter than that of the first, but is much broader, and is flattened. The sutures with the ribs are straight, and the ribs are in contact with the centrum throughout practically the entire length of the latter.

The ribs are massively constructed. They are broad antero-posteriorly and apparently vertically as well. An oblique development causes them to exhibit a twisted appearance. The anterior corners of their distal ends are not far from the centra and are low in position, but the posterior corners are far from the centra and are high. Thus the articular surfaces are oblique in position. These surfaces are large.

CHARACTERS OF THE CAUDAL VERTEBRAE

Two caudals are fairly well-preserved, and a third is less well-preserved.

The first caudal has a short centrum. The character of the articular surfaces cannot be made out. The transverse processes are of moderate length; they are broad antero-posteriorly at their bases, and taper rapidly toward their extremities. They are directed backward in a curve which affects their entire lengths.

The second caudal has a long centrum that is rounded inferiorly. The transverse processes of this vertebra are longer and more slender than those of the first caudal.



Fig. 4. *Goniopholis* sp. Scutes. U. S. Nat. Mus. No. 5836. Natural size. Dorsal view.

The third caudal is not sufficiently well preserved to admit description except to state that the centrum is shorter than that of the second caudal, and is about equal in length to that of the first caudal.

CHARACTERS OF BONES OTHER THAN VERTEBRAE

The left ilium is well-preserved. It is shorter and proportionally higher than the normal crocodilian ilium of to-day. The anterior peduncle is strongly developed, and is excavated in such a way in its acetabular aspect as to indicate that the dominant thrust from the femur was backward, and downward, and outward, and that the backward component of this thrust was greater than in living crocodilians.

Several dorsal scutes are preserved, and some of them appear to be in their original positions. A fragmentary scute overlies the seventeenth presacral. An incomplete scute overlies the fourteenth. Complete scutes overlie the twelfth and eleventh presacrals. These two are well-preserved. That over presacral twelve has elongate, parallel transverse borders. The anterior border is much shorter than the posterior border, and the external border is inclined inward in the anterior direction. The internal, or median, border is straight. The scute over presacral eleven is slightly narrower antero-posteriorly at its external than at its internal end. Its external and internal borders are parallel to the mid-line of the body.

The scute over presacral seven is long in the transverse direction, and is slender antero-posteriorly. It is subrectangular in outline. Its antero-internal and postero-internal corners are produced into hook-like processes.

All of these scutes have their internal borders arranged in line immediately over the vertebral spines, and are only slightly separated from the latter. They have apparently not been disturbed from their original positions. They indicate two rows of scutes for the dorsal region lying immediately over the vertebrae, without development of muscular tissue between the spines and the scutes. Each scute has many pits, but the pits are small in size and simple in form.

MEASUREMENTS

Length of vertebral column, presacral 16 to caudal 3, measured along arc.....	177 mm.
Breadth across broadest transverse processes (est.).....	29.5
Length of sacrum.....	17.5
Breadth of sacrum (est.).....	23.5
Length of ilium.....	21.5
Height of ilium.....	15.5
Transverse diameter of scute over presacral 7.....	23.0
Antero-posterior diameter of scute over presacral 7.....	10.5

CONCLUSIONS

Goniopholid skulls and jaws and teeth are not particularly common, but they are not rare. Articulated vertebrae, however, are very rare, and this specimen serves to illustrate skeletal characters of the group, even though the generic and specific identification is not certain.

THREE OBSCURE GENERA OF PONERINE ANTS

BY WILLIAM MORTON WHEELER

The recent discovery by Mr. R. H. Van Zwaluwenburg of two singular species of ponerine ants in Hawaii has induced me to study the genus *Cryptopone*, established by Emery in 1893 for a small Ceylonese worker ant, which he regarded as conspecific with a female specimen described by Motschulsky in 1863 as *Amblyopone* (?) *testacea*. Emery's description is preceded by the following generic diagnosis:

"WORKER. Clypeus carinate, its anterior border broadly arcuate, acute, edentulous. Mandibles narrow, masticatory border very oblique, 5-toothed. Eyes absent. Frontal laminae short, approximated. Antennae 12-jointed, with 4-jointed club. Thorax with distinct sutures. Peduncle [petiole] of abdomen nodiform, inserted at a third of the height of the anterior surface of the abdomen [postpetiole]. Legs stout, short, with the first tarsal joint much shorter than the tibiae; spurs with long pectination; claws simple.

"Facies that of a *Ponera*, but differing in the insertion of the pedicel [petiole] at about a third of the anterior face of the following abdominal segment [postpetiole], in the mandibles, which have a very oblique masticatory border, and in the antennae, the four last joints of which form a very distinct club. The two former of these characters place this genus near *Trapeziopella*, from which it differs in its clypeus and antennae. Antennae with a distinct club are also found in *Typhlomyrmex* and *Myopias*; this last genus is unknown to me in nature."

In the ponerine section of the 'Genera Insectorum,' published in 1911, Emery cites five species of *Cryptopone*, four of which had been added since 1893, namely, *fusciceps* Emery (1900), *tenuis* Emery (1900), and *mocsaryi* Szabó (1910), all from New Guinea, and *nicobarensis* Forel (1905) from the Nicobar Islands. In order to include these four species in the genus, Emery had to modify his generic diagnosis, which now reads as follows:

"WORKER: Head relatively short, slightly longer than broad. Anterior border of clypeus straight or well-rounded. Mandibles narrower than in *Ponera*, armed with four or five stout teeth, or with the masticatory border toothless posteriorly and with three teeth anteriorly

(*C. tenuis*). Antennae short and stout, the funiculus ending in a sharply defined 4-jointed club. Eyes vestigial or absent. Otherwise like *Ponera*.

"FEMALE: Winged; eyes and ocelli developed.

"MALE: Unknown.

"TYPE OF THE GENUS: *Cryptopone testacea* Motschulsky.

"GEOGRAPHICAL DISTRIBUTION OF THE SPECIES: Ceylon, Nicobar, New Guinea."

More recently Forel (1912) has described a species, *butteli*, from Sumatra and Java, and Mann (1919) another, *mayri*, with a variety *fuscior*, from the Solomon Islands. This variety I regard as a distinct species and in the present paper add another species, which belongs to the genus *Cryptopone* as defined by Emery in 1911, from Borneo.

It will be seen that Emery's revised diagnosis of *Cryptopone* in the 'Genera Insectorum' is very indefinite compared with his original diagnosis of 1893, and it is easy to trace this to his inclusion of the two species, *tenuis* and *mocsaryi*, the workers of which differ greatly in the structure of their mandibles from the three other species, *testacea*, *fusciceps*, and *nicobarensis*. While I have not seen specimens of any of these five species, those that I have examined show the same dualism of characters, so that I suggest a division of the genus *Cryptopone*, as conceived by Emery in 1911, into two genera, *Cryptopone*, with *testacea* Motschulsky as the genotype, and *Pseudocryptopone*, new genus, for which I select as the genotype *Cryptopone tenuis* Emery. The worker and female of the former genus are characterized mainly by possessing narrow mandibles with five (in *nicobarensis* and *sarawakana*, new species, with six) strong teeth, and in having the middle tibiae very short and conspicuously bristly on their extensor surfaces, while the worker is also distinguished by having the epinotum in profile somewhat lower than the promesonotum, and strongly compressed above and anteriorly so that its base in dorsal view is very distinctly narrowed at the middle of the mesoëpinotal suture, which is always well-developed. In *Pseudocryptopone*, on the other hand, the mandibles of the worker and female are broad and triangular as in *Ponera*, with very distinct internal and masticatory border and the latter toothless on its basal half and furnished with three (or in *mocsaryi* with four) small teeth on its apical half. The middle tibiae are very short as in *Cryptopone*, but their extensor surfaces are not furnished with bristles. In the worker the epinotum is as high as and not much narrower than the promesonotum, parallel-sided above, and not conspicuously compressed anteriorly. The mesoëpinotal suture is usually obsolete.

Emery emphasized the distinctness of the 4-jointed antennal club, but this does not seem to be a good character. In most of the species that I have examined the club, owing to the greater width and length of the seventh funicular joint, might be more aptly described as indistinctly or even distinctly 5-jointed. This is a character of many species of *Ponera*, while in others (e.g., *leae* Forel, *mina* Wheeler, *japonica* Wheeler, *mumfordi* Wheeler) the antennal club is much more sharply 4-jointed than in any of the species of *Cryptopone* or *Pseudocryptopone*. The shape of the head, as described by Emery, is a more satisfactory character. His remark that it is "relatively short, slightly longer than broad," applies to the species of *Cryptopone*, *sensu stricto*, but not to his *tenuis* nor to Szabó's *mocsaryi*, in both of which the head is fully one-fourth longer than broad. It is quite as long or even longer in the three new species of *Pseudocryptopone* described below.

The two genera seem to me also to have different natural affinities. *Cryptopone*, *sensu stricto*, is obviously most closely related to the subgenus *Trachymesopus* Emery of the genus *Euponera*, as shown by the shape of the head and the short and bristly middle tibiae, whereas *Pseudocryptopone* is most closely related to *Ponera*. Indeed, I confess my inability to draw a sharp line of demarcation between the two genera. One of the species, *incerta*, new species, which I have assigned to *Pseudocryptopone*, might, with equal propriety, be placed in *Ponera*. Since *Cryptopone* is a clearly defined genus, whereas *Pseudocryptopone* merges into *Ponera*, two courses seem to be open to us: we may regard *Pseudocryptopone*, at least provisionally, as a distinct genus or subgenus of *Ponera*, or we may transfer all the species with mandibles and thorax like *Ponera* to that genus. I have adopted the former course for the following reasons. *Ponera* is now a large and very difficult genus in great need of careful revision. The monographer who undertakes this task will very probably divide it into several subgenera or even genera and his definition of these will automatically determine their relations to *Pseudocryptopone* and therefore its true status and affinities. For the present, I prefer to circumscribe the genus *Cryptopone* more sharply and to recognize a generic category for the species closely related to *C. tenuis*, which, after all, have a habitus distinctly different from that of the typical species of *Ponera*. I have, moreover, ventured to withdraw two of Emery's Papuan species (*selenophora* and *clavicornis*) from the genus *Ponera* and to associate with them a closely related, undescribed species from the Philippines (*oreas*, new species) to form another new genus, *Selenopone*.

The only males that I possess belong to two species of *Cryptopone*,

butteli Forel and *sarawakana*, new species, and are very similar to the males of *Ponera* and *Euponera*. The same is probably true of the unknown males of *Pseudocryptopone* and *Selenopone*. The females of *Cryptopone*, *Ponera* and *Pseudocryptopone* and the males of the two former genera have distinctly hairy eyes. Perhaps a study of the male genitalia in the four genera would yield valuable taxonomic characters, but for this purpose we shall have to await the accumulation of more material than is to be found in any existing collection.

The known geographical range of species assigned to *Cryptopone*, *Pseudocryptopone*, and *Selenopone* in the following pages comprises a zone of islands extending from Ceylon to Hawaii and from the Philippines to New Guinea and the Solomons. The only species that has been taken on the Asiatic continent is *C. testacea*, which Forel records from Malacca, at the tip of the Malay Peninsula.

In their habits the species of *Cryptopone* and *Pseudocryptopone* are evidently very much like the species of *Ponera*, though, perhaps, more hypogaeic. This is indicated by the even greater reduction of the eyes or their complete absence in the workers. According to Mann, the colonies of *C. mayri* and *fuscior* are small and nest under stones. Forel records *C. testacea* as nesting in a termitarium of *Capritermes nemorosus* Silvestri and *C. butteli* as nesting under tussocks of grass. The sexual forms of this species were taken by H. H. Karny at lights in the house. The two Hawaiian species, *Ps. zwaluwenburgi*, new species, and *swezeyi* new species, were taken by Van Zwaluwenburg in the soil of sugar-cane fields.

CRYPTOPONE Emery (emended)

WORKER.—Stature small. Head subrectangular, slightly longer than broad and very slightly narrower in front than behind. Eyes absent in most of the species; when present, vestigial and minute, situated at the anterior fifth of the head. Mandibles narrow, without distinct internal and masticatory borders, furnished with five or six stout, subequal teeth. Clypeus short, narrowly convex and subcarinate in the middle, depressed on the sides, its anterior border straight or feebly rounded. Antennae rather stout; funiculi with joints 2-6 short and transverse, joint 7 slightly longer, and joints 8-11 forming a 4-jointed club, which is decidedly longer and thicker than the remainder of the funiculus. Thorax with both promesonotal and mesoepinotal sutures very distinct. Promesonotum large, broadly elliptical, slightly depressed dorsally, much broader than the epinotum, from which it is sharply marked off. Base of the epinotum in profile distinctly lower than the promesonotum, laterally compressed in front, with its dorsal surface elongate-ovate and narrowing more or less acutely to its junction with the mesonotum. Petiole nodiform, subcuboidal or sub-squamiform, with longitudinal, more or less fenestrate ventral lamina, and inserted on the postpetiole at a point nearly one-third the distance from the ventral to the

dorsal border of its anterior surface. Postpetiole truncate or even somewhat concave anteriorly, posteriorly distinctly marked off from the rather long gastric segments. Legs stout; median pair with conspicuously short tibiae and tarsi, which are beset with short bristles on their extensor surfaces. Sting long and well-developed. Sculpture rather opaque, especially of the head and pronotum, which are always finely and densely punctate. Pilosity and pubescence short, the latter abundant.

FEMALE.—Only slightly larger than the worker. Head very similar, but with distinct ocelli and well-developed, flattened, hairy eyes situated very near the anterior corners.

Epinotum shorter than in the worker, not lower than the more anterior segments, with its base parallel-sided above, not narrowed in front. Petiolar node somewhat more attenuate or anteroposteriorly compressed above than in the worker; remainder of abdomen and appendages very similar. Wings rather long, their membranes dull, finely and abundantly pubescent; venation as in *Ponera*, with long, closed radial cell, two cubital cells and a discoidal cell.

MALE.—Resembling the male of *Ponera*. Scarcely larger than the worker; slender. Eyes very large, hairy, situated at the extreme anterior corners of the head; ocelli large, rather prominent. Mandibles very small, vestigial, edentate. Antennae long and slender; scapes less than twice as long as broad, somewhat longer but of the same width as the first funicular joint; remaining joints more slender, longer, subcylindrical. Mesonotum without notauli but anteriorly with a distinct median groove. Petiolar node with long, convex anterior slope, vertical posterior surface and rounded apex. Remainder of abdomen long and slender; postpetiolar segment not marked off from the gastric segments. Legs slender, the median pair not modified as in the worker and female; all the tibiae with well-developed pectinate spurs. Wings like those of the female.

GENOTYPE.—*Amblyopone* (?) *testacea* Motschulsky.

KEY TO THE WORKERS OF *Cryptopone*

- 1.—Eyes present; epinotum evenly convex in profile, without distinct base and declivity. Length, 1.6–1.8 mm. New Guinea.....*fusciceps* Emery.
Eyes absent; epinotum distinctly angulate in profile.....2.
- 2.—Sides of head rather strongly convex; anterior surface of petiolar node straight. Length, 2.5 mm. Ceylon; Malacca.....*testacea* Motschulsky.
Sides of head straight and subparallel or feebly convex; anterior surface of petiolar node distinctly concave.....3.
- 3.—Head nearly square, with subparallel sides; antennal scapes reaching very nearly to the posterior border of the head; anterior end of basal surface of epinotum contracted to a point at the middle of the mesoepinotal suture; summit of petiolar node fully three times as broad as long. Length, 2 mm. Sumatra; Java.....*buteli* Forel.
Head longer, with feebly convex sides; antennal scapes shorter; anterior end of basal surface of epinotum less contracted; summit of petiolar node narrower.....4.
- 4.—Mandibles 6-toothed. Length, 2–2.3 mm. Borneo....*sarawakana*, new species.
Mandibles 5-toothed.....5.
- 5.—Summit of petiolar node less than twice as broad as long; color ferruginous, head somewhat darker. Length, 2.5–2.7 mm. Solomon Islands....*mayri* Mann;

Summit of petiolar node more compressed anteroposteriorly, twice as broad as long. Color dark brown, nearly black. Length, only 2 mm. Solomon Islands.....*fuscior* Mann.

C. nicobarensis Forel, known only from the female, is not included in the table.

***Cryptopone testacea* (Motschulsky)**

Amblyopone (?) *testacea* MOTSCHULSKY, 1863, Bull. Soc. Nat. Moscou, XXXVI, p. 15, ♀.

Cryptopone testacea EMERY, 1893, Ann. Soc. Ent. France, pp. 240, 241, Figs. 3 and 4, ♀. BINGHAM, 1903, 'Fauna Brit. Ind. Hymen.,' II, p. 105, ♀, ♀. EMERY, 1911, Ponerinae, in 'Genera Insect.,' p. 88, ♀, ♀. FOREL, 1913, Zool. Jahrb. Abt. Syst., Bd. 63, p. 10, ♀.

The worker described by Emery was taken by E. Simon at Nawalapitya, Ceylon. Forel possessed specimens of the same caste collected by H. von Buttel-Reepen at Selangor, Malacca, "from an earthy carton termitarium of *Capritermes nemorosus* Silvestri." According to Emery, the worker measures only 2.5 mm., but Motschulsky's female measured 2 lines (5 mm.). Since the known females of other closely allied species are only slightly larger than their workers, Emery's specimen may not belong to Motschulsky's species. In Emery's figure the sides of the head are represented as decidedly convex, the antennal scapes as reaching nearly to the posterior border, the petiolar node as thick and as having a straight anterior surface. In both workers and females of all the other species of *Cryptopone* the head is nearly square and the petiolar node is more subcuboidal in profile, with a distinctly concave anterior surface.

***Cryptopone nicobarensis* Forel**

Cryptopone nicobarensis FOREL, 1905, Ann. Soc. Ent. Belgique, XLIX, p. 166, ♀. EMERY, 1911, Ponerinae, in 'Genera Insect.,' p. 88, ♀.

Forel described this species from a deãlated female specimen, labelled "Nicobars," in the Copenhagen Museum, as having six mandibular teeth and 4-5-jointed antennal clubs. The length is given as 3.5 mm. He remarks that "though it is a female, I believe this species to be quite distinct from *testacea* Motschulsky, which is smaller, has a paler color, more abundant pilosity and a differently shaped node and mandibles." This contention may be correct, but it should be noticed that Motschulsky's specimen was not smaller but actually twice as long as Forel's *nicobarensis* female. It is therefore difficult to avoid the suspicion that the latter may be the undescribed female of Emery's "*testacea*" and that his worker may not belong to the same species as Motschulsky's female.

Cryptopone fusciceps Emery

Cryptopone fusciceps EMERY, 1900, Termesz. Füzetek, XXIII, p. 321, Pl. VIII, figs. 19 and 20, ♂, ♀. 1911, Ponerinae, in 'Genera Insect.', p. 88, ♂ ♀. MANN, 1919, Bull. Mus. Comp. Zool., LXIII, pp. 293, 294, ♂.

This species is clearly quite distinct from *testacea*. Both the worker and the female are decidedly smaller, measuring only 1.66–1.75 mm. and 2.5 mm. respectively. The worker differs from those of all the other species of the genus in possessing eyes and in the shape of the epinotum, which is evenly arcuate and not angulate in profile. Its basal surface, as shown in Emery's figure, is less than twice as long as broad and distinctly, but not greatly narrowed anteriorly at the middle of the pronounced mesoepinotal suture. The petiolar node is as high as its basal length, narrowed above, with concave anterior and nearly straight posterior surface. Seen from above it is broader than long. The color is reddish testaceous, with the head fuscous and the mandibles, scapes, legs, and anal region yellowish testaceous. The head and pronotum are opaque, finely and densely punctate, the epinotum, pleurae, and abdomen shining. The body is covered with very short, dense pubescence and short, sparse hairs, which are most numerous on the abdomen.

The female is more opaque and has stouter antennae, with thicker clubs, than the worker.

The type-specimens were taken at Lemien, New Guinea, by L. Biró.

Cryptopone mayri Mann

Figure 1, *a* to *d*

Cryptopone mayri MANN, 1919, Bull. Mus. Comp. Zool., LXIII, pp. 293, 294, ♂ ♀.

This species was described from workers and females taken by Dr. Mann on three of the Solomon Islands (Ysabel, Ugi, and San Cristoval). I have drawn the accompanying figures (Fig. 1, *a* to *d*) from seven workers which he generously contributed. The head is distinctly longer than broad, with evenly but not strongly convex sides and feebly concave posterior border. Eyes absent. Joints 2–7 of the antennal funiculi broader than long but less transverse than in some of the other species. Mesoepinotal suture stronger and more impressed than the promesonotal. Epinotum in profile distinctly angular though both the base and declivity are sloping; the former about one and one-half times as long as broad; contracted anteriorly; mesopleurae strongly concave in front. Petiole somewhat broader than long, its node rounded-cuboidal, with perpendicular, distinctly concave anterior, and convex and more sloping posterior

surface. Ventrally the petiolar segment depends as a translucent lamina which is deepest anteriorly. The specimens vary from brownish yellow to ferruginous, with somewhat darker head and conspicuously pale or even whitish mesonotum. Length, 2.5–2.75 mm.

According to Mann, the female measures 3 mm. and possesses large, flat, anteriorly situated eyes and small ocelli. The wings, which are as long as the body, are strongly infuscated.

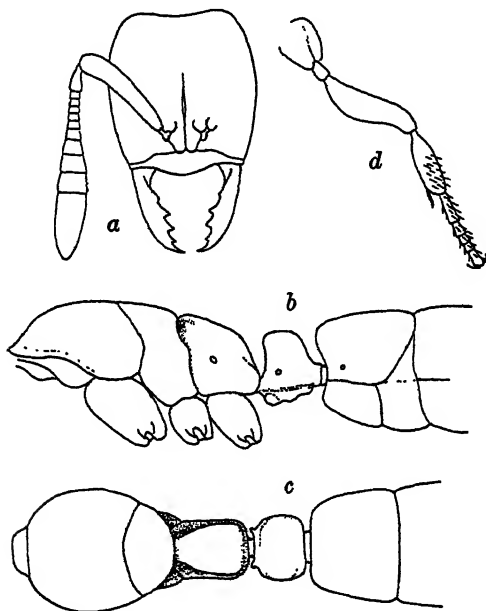


Fig. 1. *Cryptopone mayri* Mann.

a, head of worker, dorsal view; b, thorax and pedicel, lateral view; c, same, dorsal view; d, middle leg.

Cryptopone fuscior Mann

Figure 2, a and b

Cryptopone mayri var. *fuscior* MANN, 1919, Bull. Mus. Comp. Zool., LXIII, p. 294, ♀.

This form was described by Dr. Mann from two workers from Ysabel Island, Solomons. It is also mentioned, apparently by an oversight, as "var. *minor*" in his table on the same page. The cotype which he gave me has unfortunately lost its head, but the small size, nearly black coloration of the body, the shape of the epinotum and petiole show that it represents a distinct species. The base of the epinotum, as shown

in figure 2b, is twice as long as broad and distinctly more attenuated where it joins the mesoëpinotal suture than in *mayri*, and the petiolar node is much more compressed dorsally and, when seen from above, nearly twice as broad as long.

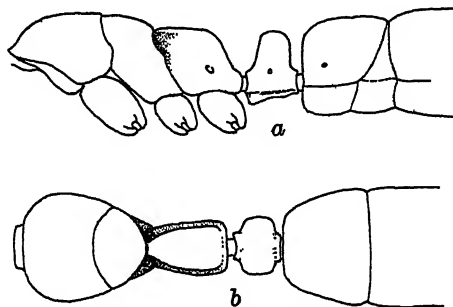


Fig. 2. *Cryptopone fuscior* Mann.
a, thorax and pedicel of worker, lateral view; b, same, dorsal view.

Cryptopone butteli Forel

Figure 3, a to c

Cryptopone butteli FOREL, 1912, Zool. Jahrb. Abt. Syst., Suppl. 15, Bd. 1, p. 9, Fig. C, ♂.

Forel described the worker of this species in detail from specimens taken by H. von Buttel-Reepen at Beras Tagi, altitude 4500 feet, Central Sumatra and Buitenzorg, Java. The head is nearly square, only slightly longer than broad, with straight posterior and feebly convex lateral borders. Mandibles 5-toothed, the subapical tooth small. Antennal scapes reaching very nearly to the posterior border of the head. Base of epinotum horizontal, narrowed anteriorly almost to a point at the middle of the mesoëpinotal suture. Petiolar node much compressed, narrowed and somewhat scale-like above in profile with concave anterior and straight posterior surface; its summit in dorsal view fully three times as broad as long.

Sculpture and pubescence much as in the other species; the pilosity very meager, confined to the thorax and petiole. Coloration sordid brownish yellow; gaster somewhat browner; mandibles and appendages more yellow; head somewhat redder than the thorax.

Two females and a defective male taken by H. H. Karny in Buitenzorg, Java, at lights, evidently represent the sexual phases of this species, and are herewith described:

FEMALE (undescribed).—Length, 2.3–2.5 mm.

Head like that of the worker but the sides nearly straight and parallel. Mandibles 5-toothed, the subapical tooth somewhat smaller than the others. Eyes flat, separated by less than half their length from the anterior corners of the head; ocelli distinct, rather widely separated. Clypeus short, subcarinate in the middle, depressed on the sides, its anterior border broadly rounded. Antennal scapes as in the worker. Pronotum rounded anteriorly and laterally, about twice as long as broad; mesonotum small, flat, trapezoidal, nearly as long as broad; epinotum subcuboidal, its base as broad as long, not narrowed anteriorly, shorter than the rather steeply sloping declivity, more rounded at the sides. Petiole like that of the worker, but the posterior surface of the node distinctly concave. Postpetiole somewhat broader behind than long, concave anteriorly at the insertion of the petiole.

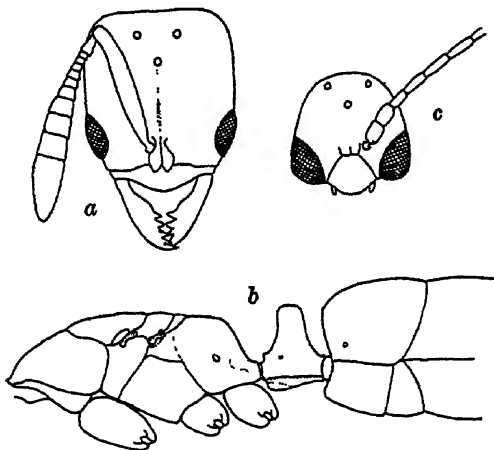


Fig. 3. *Cryptopone butteli* Forel.

a, head of female, dorsal view; b, thorax and pedicel, lateral view, c, head of male, dorsal view.

Mandibles shining, sparsely and finely punctate; remainder of body opaque or subopaque, except the epinotum, which is distinctly shining. Head densely, remainder of body finely and more superficially punctate.

Pubescence fine, abundant, short and dense as in the worker; hairs short, confined to the clypeus and terminal gastric segments; middle tibiae with numerous short bristles on their extensor surfaces. Eyes hairy. Wing membranes finely and densely pubescent.

Reddish brown; head and gaster somewhat darker; ocellar triangle black; pleurae, clypeus, mandibles, and antennae brownish yellow; legs paler yellow. Wings long, dull, brownish, the veins and pterostigma darker brown; tegulae and wing insertions yellow.

MALE (undescribed).—Length, about 2 mm.

Head through the large and prominent eyes as broad as long, rounded and somewhat narrowed posteriorly. Eyes very close to the anterior corners of the head, so

that the cheeks are extremely short. Ocelli prominent, widely separated. Clypeus convex in the middle, with rounded anterior border. Mandibles very small, vestigial, rounded, edentate. Frontal carinae short and indistinct. Antennal scape only twice as long as broad and closely resembling the first funicular joint in size and shape; remainder of funiculus more slender, its basal joints cylindrical, less than three times as long as broad. Thorax resembling that of the female but narrower, the epinotum shorter and more rounded. Legs slender. Abdomen missing.

Sculpture, pilosity and color much as in the female, but head black and very finely rugulose anteriorly; antennae and mouth parts pale yellow. Wings like those of the female but much shorter.

Cryptopone sarawakana, new species

Figure 4, *a* to *d*

WORKER.—Length, 2–2.3 mm.

Head distinctly longer than broad, nearly as broad in front as behind, with somewhat convex sides and feebly concave posterior border. Eyes absent. Mandibles 6-toothed, the basal and subapical tooth small. Clypeus short, convex and subcarinate in the middle, depressed on the sides, its anterior border broadly rounded. Frontal carinae small, closely approximated; frontal groove distinct as far back as the middle of the head. Antennal scapes somewhat flattened and thickened distally, reaching a little more than their greatest diameter from the posterior border of the head; funicular joints 2–6 small, strongly transverse, the 7th somewhat longer, the 4-jointed club well-developed. Promesonotum large, broadly elliptical, somewhat depressed dorsally; mesoepinotal suture strongly impressed; epinotum very distinctly lower than the promesonotum; its base horizontal, rounding into the straight, sloping declivity, which is of the same length. Seen from above the base is strongly contracted at its junction with the middle of the mesoepinotal suture, but less so than in *C. butteli*. Petiole slightly longer than broad, rounded-subrectangular, as broad as the epinotum; its node in profile narrowed above, with rounded summit twice as broad as long, its anterior surface sloping and feebly concave, its posterior surface straight and perpendicular; ventral lamina well-developed, translucent. Postpetiole broader than long, its truncated anterior surface slightly concave at the insertion of the petiole. Legs stout, median tibiae with bristly extensor surface.

Mandibles shining, finely and sparsely punctate. Head opaque and densely, remainder of body subopaque and more finely and sparsely punctate.

Pubescence and pilosity yellow, the former fine and dense as in the other species, the latter short, sparse, confined to the clypeus, mouthparts, epinotum, petiole and terminal gastric segments.

Yellowish brown; head and gastric segments darker brown; antennae and legs sordid yellowish; mandibles either nearly as dark as the head or paler brown like the thorax.

MALE.—Length, 2.2–2.4 mm.

Slender. Head like that of *butteli* but broader, with somewhat larger ocelli; clypeus with a prominent median tubercle near the base and straight, transverse anterior border. There is a deep pit just in front of the anterior ocellus. Antennae longer than in *butteli*; the first funicular joint distinctly shorter than the scape and the remaining joints longer. Mandibles small, vestigial, membranous. Thorax but

slightly broader than the head; mesonotum convex, somewhat broader than long, with a short, median groove anteriorly. Epinotum small and low, rounded, without very distinct base and declivity. Petiolar node lower in profile than in the worker, with straight anterior slope. Gaster and legs long and slender. Wings distinctly longer than in *butteli*.

Subopaque; abdomen more shining; head coarsely, remainder of body more finely punctate.

Pubescence and pilosity as in the worker, but the hairs, though sparse, more uneven and more generally distributed. Eyes hairy; wing membranes densely pubescent.

Piceous brown, appendages slightly paler; head black; wings more infuscated than in *butteli*, with brown veins and pterostigma.

Described from two workers and three males taken by Dr. E. Mjöberg on Mt. Poi, Sarawak, Borneo.

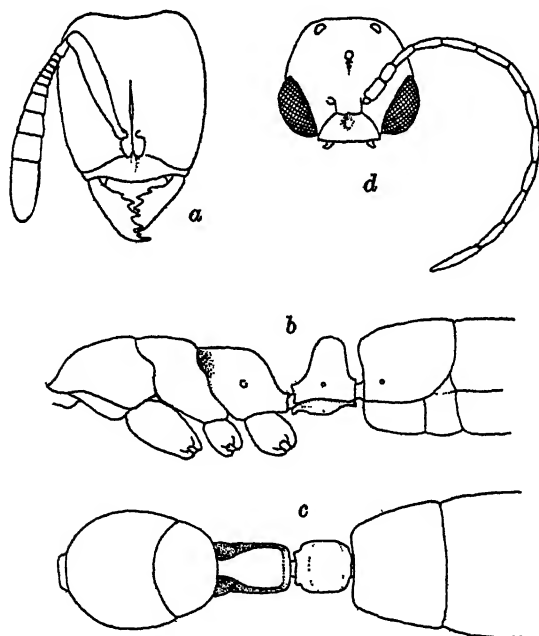


Fig. 4. *Cryptopone sarawakana*, new species.

a, head of worker, dorsal view; b, thorax and pedicel, lateral view; c, same, dorsal view; d, head of male, dorsal view.

PSEUDOCRYPTOPONE, new genus

WORKER.—Closely resembling the worker of *Ponera*: small and slender. Head subrectangular, decidedly longer than in *Cryptopone*. Eyes absent or vestigial and minute, situated near the anterior corners of the head. Mandibles broad, triangular,

with distinct internal and masticatory border, the latter with three or four small teeth on the apical half, the basal half straight and edentate. Clypeus short, convex and subcarinate in the middle, with entire, broadly rounded anterior border. Frontal carinae small, lobular, closely approximated and ciliated; frontal groove distinct. Antennae stout; scapes not reaching to the posterior border of the head; funiculi with thickened, 4-jointed club; joints 4-6 short and transverse. Promesonotum smaller, narrower and more depressed than in *Cryptopone* as compared with the epinotum, the base of which is of the same height, so that the dorsal outline of the thorax is straight and horizontal in profile; mesoepinotal suture usually less distinct than the promesonotal or absent; epinotum not laterally compressed anteriorly, the sides of the base being subparallel. Petiole nodiform, much as in *Cryptopone*, with the same high insertion on the truncated anterior surface of the postpetiole. Legs stout, median tibiae and tarsi short but not furnished with numerous bristles on their extensor surfaces. Sting long and stout. Sculpture and pilosity much as in *Cryptopone*.

FEMALE (deilated).—Scarcely larger than the worker and very similar, but with distinct ocelli and moderately large, flattened, hairy eyes, situated near the anterior corners of the head. Mesonotum small and flat. Venation of wings unknown but very probably like that of *Ponera* and *Cryptopone*.

MALE.—Unknown.

GENOTYPE.—*Cryptopone tenuis* Emery.

KEY TO THE WORKERS OF *Pseudocryptopone*

- 1.—Mesoepinotal suture very distinct, impressed; eyes absent; petiole as long as high, its node not strongly compressed anteroposteriorly; color brownish yellow. Length 2-2.3 mm. Hawaii.....*zwaluwenburgi*, new species.
Mesoepinotal suture indistinct or obsolete; smaller species.....2.
- 2.—Eyes absent.....3.
Eyes present.....4.
- 3.—Head one-fourth longer than broad; mandibles 4-toothed; color ferruginous brown. Length 1.66-1.75 mm. New Guinea.....*tenuis* Emery.
Head one-third longer than broad; mandibles 3-toothed; color brownish yellow. Length only 1.2-1.4 mm. Hawaii.....*svezeyi*, new species.
- 4.—Antennal scapes reaching only to the posterior third of the head; petiolar node from above rounded-rectangular; color yellow. Length 1-1.2 mm. New Guinea.....*mocsaryi* Szabó.
Antennal scapes longer; petiole higher, with a more anteroposteriorly compressed node, which is distinctly semicircular from above; color reddish brown. Length 1.5 mm. Java.....*incerta*, new species.

Pseudocryptopone tenuis (Emery)

Cryptopone tenuis EMERY, 1900, Termeszeti. Füzetek, XXIII p. 321, Pl. VIII, figs. 21, 22, ♂ ♀. EMERY, 1911, Ponerinae, in 'Genera Insect.', p. 88, ♂ ♀.

Emery gives figures and a rather brief description of this form, which was taken by L. Biró on Tamara Island, Lemien, New Guinea. The worker measures 1.66-1.75 mm.; the female 2.25 mm. The head of the former is about one-fourth longer than broad; the mandibles with

four teeth anteriorly. Eyes absent. Dorsal outline of thorax in profile straight and horizontal; base of epinotum parallel-sided; mesoëpinotal suture obsolete. Petiole as long as broad but higher than long, the node in profile slightly attenuate above, with straight anterior, posterior, and superior surfaces. Sculpture and pubescence as in *Cryptopone fusciceps* Emery, color a little darker.

***Pseudocryptopone mocsaryi* (Szabó)**

Cryptopone mocsaryi SZABÓ, 1910, Rovartani Lapok, XVII, p. 186, Fig. 1, ♀. EMERY, 1911, Ponerinae, in 'Genera Insect.', p. 88, ♀.

WORKER (after Szabó).—"Yellow, slightly shining; antennae, mandibles and legs paler. Head densely, thorax more sparsely punctate. Body densely and finely pubescent; clypeal border ciliate; abdomen pilose posteriorly. Head elongate, about one-fourth longer than broad; slightly narrowed anteriorly, truncate posteriorly, with rounded posterior corners. Eyes minute, situated at the anterior fifth of the sides of the head. Mandibles short, with three larger teeth at the apex, posteriorly with obtuse denticles. Antennal scape short, extending back about two-thirds the length of the head; funiculus slender at the base, with the joints preceding the 4-jointed and strongly incrassate club very short. Thoracic dorsum nearly straight; pronotum rounded, seen from above scarcely narrowed in the region of the mesoëpinotal suture [which is absent]; epinotum with a distinct angle between the base and declivity, the latter slightly sinuous. Petiolar scale scarcely attenuate above, its anterior and posterior surfaces subparallel. Postpetiolar segment of abdomen slightly concave anteriorly. Length, 1-1.2 mm.

"Closely related to *C. tenuis* Emery, but differing in the smaller size of the body, shorter antennal scape and the slightly concave anterior surface of the postpetiolar segment."

The type specimen was collected by L. Biró in 1901 at Friedrich-Wilhelmshafen, New Guinea, and is deposited in the Hungarian National Museum.

***Pseudocryptopone zwaluwenburgi*, new species**

Figure 5, *a* to *c*

WORKER.—Length, 2-2.3 mm.

Head suboblong, nearly one-third longer than broad, with straight, subparallel sides, rounded anterior and posterior corners and distinctly concave posterior border. Eyes absent. Mandibles with three small apical teeth, the basal half of the masticatory border straight, evenly and microscopically pectinate. Clypeus bluntly subcarinate, with broadly and evenly rounded anterior border. Frontal carinae of the

usual shape; frontal groove reaching to the middle of the head. Antennae stout; scapes distinctly thickened distally, reaching a distance equal to their greatest diameter from the posterior border of the head; club of funiculus distinctly 5-jointed; joints 2-6 narrow and transverse. Pronotum less than twice as long as broad, somewhat depressed above; mesonotum transversely elliptical, very slightly more convex than the mesonotum; mesoepinotal suture quite as distinct as the promesonotal. Epinotum from above less than twice as long as broad, with nearly parallel sides, its dorsal surface rounded laterally and posteriorly; the base and declivity straight in profile, the former horizontal, the latter rather steep, the angle between rounded. Petiole as broad as long, from above trapezoidal, narrowed anteriorly and truncate behind; in profile as long as high, the node narrowed above, with straight, sloping,

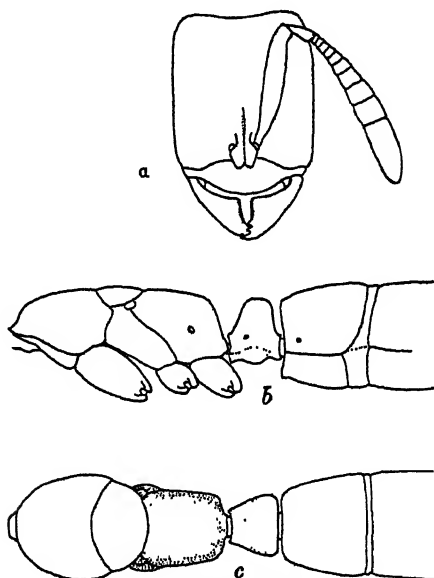


Fig. 5. *Pseudocryptopone zwaluwenburgi*, new species.

a, head of worker, dorsal view; b, thorax and pedicel, lateral view; c, same, dorsal view.

subequal anterior and posterior surfaces and horizontal, laterally rounded superior surface, which is twice as broad as long. Postpetiole narrow, trapezoidal, as long as broad. Gaster very long and slender, its first and second segments subequal, about one and one-half times as broad as long. Sting very large. Legs rather long, moderately stout.

Mandibles, epinotum, abdomen and legs shining, very finely punctate; dorsal surface of head, promesonotum and pleurae more opaque and more densely punctate; the punctures of the head coarser and deeper.

Pubescence yellowish, very short and fine, dense and appressed, but not concealing the surface, most conspicuous on the head; hairs erect, fine and short, sparse and

rather generally distributed but more numerous on the abdomen, longer on the clypeus.

Brownish yellow; appendages not paler than the body; anterior border of clypeus and masticatory border of mandibles red.

Described from eleven specimens taken by Mr. R. H. Van Zwaluwenburg at Waimalo, Waialua, and Waipio on Oahu Island, and also on Maui Island, Hawaii. They were living some inches below the surface in the soil of both cultivated and fallow sugar-cane fields.

***Pseudocryptopone swezeyi*, new species**

Figure 6, *a* to *d*

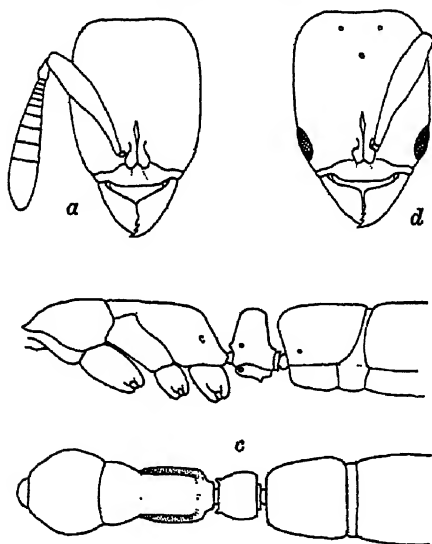


Fig. 6. *Pseudocryptopone swezeyi*, new species.

a, head of worker, dorsal view; *b*, thorax and pedicel, lateral view, *c*, same, dorsal view; *d*, head of female, dorsal view.

WORKER.—Length, 1.2–1.4 mm.

Head subrectangular, nearly one-third longer than broad and nearly as wide in front as behind, with feebly and evenly rounded sides and straight posterior border. Eyes absent. Mandibles with three small, very oblique apical teeth. Clypeus bluntly subcarinate, its anterior border nearly straight and transverse in the middle, sinuate on each side. Frontal carinae small, closely approximated; frontal groove distinct, reaching nearly to the middle of the head. Antennal scapes distinctly incrassated and somewhat flattened distally, reaching to a distance less than their greatest diameter from the posterior border of the head; funiculi with all the joints, except the first and last, much broader than long, the club thick, indistinctly 5-jointed. Thorax narrow,

with straight, horizontal dorsal outline; pronotum, including the neck, nearly as long as broad, somewhat depressed dorsally; mesonotum rather broad, subtrapezoidal, with rounded sides; mesoepinotal suture indistinct; epinotum about one and two-thirds times as long as broad, base straight with subparallel, submarginate sides, somewhat longer than the straight, sloping declivity. Petiole somewhat broader than long, broader behind than in front, with moderately convex sides and straight posterior border; in profile higher than long, narrowed above, straight anteriorly, above and posteriorly, the anterior surface distinctly convex from side to side, the posterior very flat, with marginate border. Postpetiole narrow, longer than broad, its nearly flat anterior surface projecting above and strongly inclined downward and backward. First gastric segment shorter than the petiole, the second and following segments very short. Sting small. Legs short and rather slender.

Shining; dorsal surface of head and thorax subopaque; mandibles very finely and sparsely punctate; head and antennal scapes densely but not sharply, thorax and petiole more sparsely and distinctly, postpetiole and first gastric segment coarsely and sparsely punctate.

Pilosity yellow; pubescence very fine and short, rather sparse on the head, thorax, petiole and legs, longer and denser on the postpetiole and gaster; hairs sparse and erect, distinct only on the clypeus, dorsal surface of petiole and terminal gastric segments.

Yellowish ferruginous; legs, antennal scapes, bases of funiculi and tip of gaster yellow; mandibular teeth and anterior edge of clypeus dark brown; posterior borders of gastric segments sometimes reddish.

FEMALE (deâlated).—Length, 1.8–2 mm.

Head somewhat broader than that of the worker, with more broadly rounded posterior corners and straight, parallel sides. Eyes small, circular, flattened and hairy, situated about one-third their diameter from the anterior corners of the head. Ocelli widely separated. Thorax long, narrower than the head, flattened dorsally; pronotum as long as broad, gradually narrowed anteriorly; mesonotum small, semicircular; tegulae well-developed; epinotum broader than long, its base transversely oblong, nearly twice as broad as long. Petiole like that of the worker, but the node more compressed anteroposteriorly, so that its summit is three times as broad as long (only about one and one-half times as broad as long in the worker). Gaster more voluminous.

Sculpture, pilosity and color as in the worker. Wings, judging from their stumps, probably densely pubescent and infuscated.

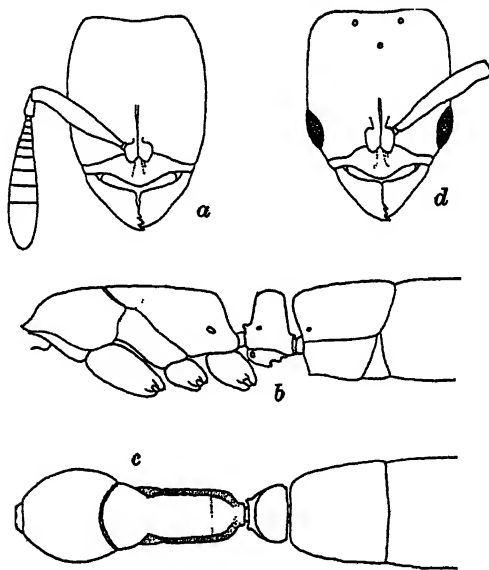
Described from seven workers and four females taken by Mr. R. H. Van Zwaluwenburg near Honolulu, Hawaii, in the soil of cultivated and fallow sugar-cane fields.

This minute species is closely related to *Ps. tenuis* Emery and *mosaryi* Szabó, but is readily distinguished by the characters mentioned in the key. It is dedicated to Mr. O. H. Swezey who has contributed so greatly to our knowledge of Hawaiian insects.

***Pseudocryptopone incerta*, new species**Figure 7, *a* to *d*

WORKER.—Length, 1.5 mm.

Head suboblong, one-fourth longer than broad, with nearly straight, subparallel sides and distinctly concave posterior border. Eyes present, minute, at about the anterior sixth of its sides. Mandibles with three small apical teeth; basal portion of masticatory border finely and indistinctly crenulate. Clypeus subcarinate, its anterior border produced in the middle, sinuate on the sides. Frontal carinae small, closely approximated, ciliated; frontal groove distinct as far back as the middle of the head. Antennal scapes reaching to its posterior sixth; clubs of funiculi thick, indistinctly 5-jointed, basal joints, except the first, short and transverse. Thorax in profile with nearly straight horizontal outline; promesonotal suture distinct, arcuate; meso-

Fig. 7. *Pseudocryptopone incerta*, new species.

a, head of worker, dorsal view; *b*, thorax and pedicel, lateral view; *c*, same, dorsal view; *d*, head of female, dorsal view.

epinotal suture absent; base of epinotum parallel-sided, longer than the declivity which is straight and marginate laterally. Petiole decidedly higher than long, node somewhat narrowed above in profile, with straight anterior and posterior slopes, the superior border straight and horizontal; seen from above the petiole is broader than long and broader behind than in front, the node semicircular, its anterior surface regularly curved from side to side, its posterior surface flat. Postpetiole nearly as broad as long, its anterior surface strongly truncated and inclined downward and backward. First gastric segment nearly as long as and slightly broader than the postpetiole; remaining segments very small. Sting well-developed. Legs rather slender.

Shining; dorsal surface of head opaque; mandibles smooth, coarsely and very sparsely punctate; head very densely, thorax and abdomen somewhat more sparsely covered with coarse, sharp punctures.

Pilosity yellowish; pubescence very short, rather abundant and dense on the head, antennae and legs, much more dilute on the thorax, petiole and postpetiole; hairs rather long, confined to the clypeus and gaster, rather abundant on the latter, subappressed on its first segment.

Reddish brown or castaneous; gaster darker; antennae paler; mandibles, legs and tip of gaster brownish yellow.

FEMALE (deãlated).—Length, 2 mm.

Head broader and more rectangular than in the worker, with straight, parallel sides and nearly straight posterior border. Eyes small, circular, flat, hairy, situated a distance equal to their diameter from the anterior corners of the clypeus. Ocelli rather large, widely separated. Thorax nearly as broad as the head, somewhat depressed dorsally; epinotum short, subcuboidal, nearly twice as broad as long, its base shorter than the abrupt declivity. Petiole broader than in the worker, with the node more compressed anteroposteriorly and its summit rounded. Postpetiole and gaster more voluminous.

Sculpture, pilosity, and color much as in the worker, but the thorax more opaque, with both the dorsum and pleurae more densely and sharply punctate. Dorsal surface of body somewhat darker brown; first gastric segment nearly black.

A single worker and female taken by Dr. H. Dammerman at Depok, Java. In habitus this species differs somewhat from the four other species of *Pseudocryptopone* and might be assigned to the genus *Ponera*.

SELENOPONE, new genus

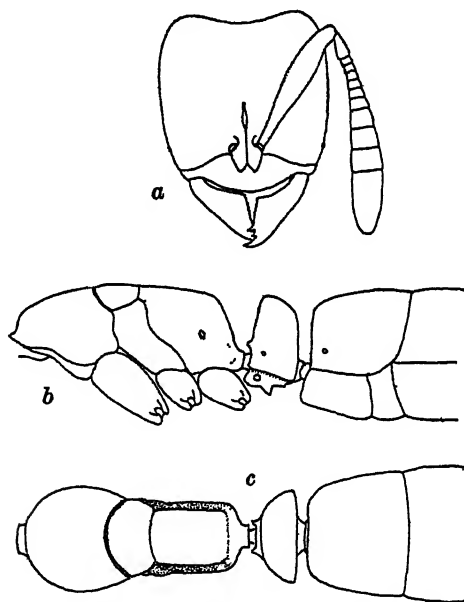
WORKER.—Closely related to *Ponera*; small and rather stout. Head broad; mandibles large and triangular, their masticatory border with three apical teeth and with or without blunt basal denticles. Clypeus ecarinate, only feebly convex in the middle, with broadly rounded, entire anterior border. Eyes very minute, convex, without distinguishable facets, situated near the mandibular articulations. Frontal carinae small and closely approximated, as in *Ponera*; frontal groove distinct but rather short. Antennae stout, clubs thick, indistinctly 5-jointed. Thorax short, its dorsal outline evenly and feebly convex; promesonotal suture very distinct; meso-epinotal suture less developed or obsolete. Epinotum narrower than the promesonotum, not strongly compressed or laterally hollowed anteriorly. Petiole much larger and broader than in *Ponera*, broader than the epinotum, its node distinctly squamiform; seen from above semicircular or crescentic, convex anteriorly, straight or subconcave posteriorly; in profile high, straight or even somewhat concave anteriorly, straight posteriorly, with its superior surface inclined backward and downward. Postpetiole and gaster much as in *Ponera* but the terminal segments small and very short. Sting large and well-developed. Legs rather stout, metatarsi shorter than the tibiae; middle tibiae without bristles on their extensor surfaces.

GENOTYPE.—*Ponera selenophora* Emery.

Selenopone oreas, new speciesFigure 8, *a* to *c*

WORKER.—Length, 1.8–2 mm.

Head subrectangular, without the mandibles scarcely longer than broad, very nearly as broad in front as behind, with feebly convex sides and rather deeply, arcuately excised occipital border. Mandibles large, flattened, with straight external borders, three well-developed apical teeth and the basal portion of the masticatory border very indistinctly crenulate. Eyes very minute, convex, without distinct facets, situated at the anterior sixth of the lateral borders. Clypeus short, slightly convex but not carinate in the middle, its anterior border broadly rounded in the middle.

Fig. 8. *Selenopone oreas*, new species.*a*, head of worker, dorsal view; *b*, thorax and pedicel, lateral view; *c*, same, dorsal view.

Frontal carinae very small, contiguous, ciliate; frontal groove extending back nearly to the middle of the head. Antennae stout, scapes reaching the occipital border of the head; funiculi with thickened, indistinctly 5-jointed clubs, joints 2–7 short and transverse. Thorax with feebly and evenly arcuate dorsal outline, epinotum distinctly subangulate, with straight base and declivity; promesonotal and mesoepinotal sutures distinct, the former impressed, the latter less pronounced. Seen from above the pronotum is convex anteriorly and laterally, excluding the neck somewhat broader than long; mesonotum small, half as long as the pronotum and twice as broad as long; epinotum narrower, slightly broader behind than in front, its base one and one-half times as long as broad, with nearly parallel, submarginate borders, the declivity

steep, flat and subcircular, shorter than the base, laterally sharply marginate. Petiole decidedly broader than the epinotum, from above semicircular, evenly convex in front, straight behind, scale in profile higher than long, straight and perpendicular anteriorly and posteriorly, the superior surface somewhat more rounded, especially posteriorly, and sloping backward and downward; ventral lamella prominent, with strong median tooth and circular anterior fenestra. Postpetiole broader than long, strongly truncated anteriorly and somewhat concave at the high insertion of the petiole. Gaster short, its first segment very similar to the postpetiole, remaining segments small and very short; sting long and stout. Legs rather long, femora and tibiae stout.

Mandibles very smooth and shining, scarcely punctate; head opaque, covered with dense, rather fine, pubigerous punctures; clypeus more shining; thorax, postpetiole and first gastric segment distinctly shining, punctate, but the punctures on the thorax finer than on the head, those on the postpetiole and gaster coarser and on all these regions decidedly sparser than on the head; declivity of epinotum and petiole very smooth and shining, the latter with a few small, scattered punctures. Antennae and legs subopaque, finely and densely punctulate, appearing somewhat scabrous.

Pilosity and pubescence whitish, the pubescence short and rather abundant on the head and appendages, not strongly appressed; on the petiolar corners, postpetiole and gaster lengthening to form rather long, oblique or reclinate hairs.

Thorax, petiole and postpetiole castaneous brown; head and gaster darker, more blackish; mandibles, clypeus, frontal carinae, antennae, legs and terminal gastric segments brownish yellow.

Described from four specimens taken by Dr. F. X. Williams, at an altitude of 4000 feet on the Cuernos Mts., near Dumaguete, Negros Oriental, Philippines.

This species is closely related to Emery's two Papuan species of which I append the translated descriptions. *S. oreas* can be distinguished from *selenophora* by its smaller size, different mandibular dentition and differently shaped petiole and epinotum; from *clavicornis* by its somewhat paler coloration, developed pilosity, more shining thorax and abdomen, longer antennal scapes, distinct mesoepinotal suture and very different epinotum.

Selenopone selenophora (Emery)

Ponera selenophora EMERY, 1900, Termesz. Füzetek, XXIII, p. 317, Pl. VIII, figs. 4-6, ♀; 1911, Ponerinae, in 'Genera Insect.,' p. 92, ♀.

"WORKER.—Fuscous black; mandibles, antennae, legs and anus red, head and thorax opaque, epinotum and abdomen shining, with abundant yellow pubescence, sparsely pilose, hairs longer toward the tip of the abdomen. Head without the mandibles slightly longer than broad, its sides moderately arcuate, occiput broadly, arcuately, not deeply excavated, densely punctate, the punctures pubigerous, the spaces between them and their centers opaque. Mandibles shining, sparsely punctate, 8-9-toothed, the anterior teeth larger, acute. Clypeus

nearly straight anteriorly, not carinate; disc of frontal carinae small, ciliate, broadly sulcate in the middle; frontal groove not reaching to the middle of the head. Eyes very minute, not distinctly composite. Antennal scape barely reaching the occipital border; funiculus gradually incrassated towards its tip; club indistinctly 5-jointed, all the joints except the first and last broader than long. Thorax stout, dorsum feebly arcuate, not impressed, basal and declivous surfaces of epinotum meeting at a very rounded angle; promesonotal suture distinct; mesoëpinotal suture feebly indicated or obsolete; mesonotum transverse, half as long as the pronotum, both, including the pleurae and all the sterna, punctate, slightly less opaque than the head above; epinotum shining, with separated piligerous punctures, slightly narrower than the pronotum, with concave sides, the declivous surface broad, transversely excavated for the reception of the petiolar scale, its sides marginate. Petiolar scale seen from above semilunar, or semicircular, convex anteriorly, nearly straight or transversely subconcave posteriorly, seen from the side nearly straight anteriorly or slightly concave, the posterior passing arcuately into the superior surface. Sculpture of the whole abdomen like that of the epinotum. Length 2.5-2.75 mm.

"Notable on account of the structure of the petiole and very minute eyes, in which separate facets are not with certainty discernible.

"Lemien (New Guinea), collected in siftings (L. Bíró)."

Selenopone clavicornis (Emery)

EMERY, 1900, *Termeszt. Füzetek*, XXIII, p. 317, Pl. VIII, figs. 7-8, ♀; 1911, *Ponerinae*, in 'Genera Insect.', p. 90, ♀.

"WORKER.—Black; mandibles, antennae, legs and anus reddish; more densely sculptured with pubigerous punctures, the spaces between which on the head, thorax and petiole are opaque throughout; gaster less opaque; erect hairs absent even on the terminal abdominal segments. Head longer than broad, with feebly arcuate sides; eyes very minute, close to the mandibular articulation; clypeus moderately convex, its border broadly arcuate; mandibles shining, sparsely punctate, masticatory border anteriorly with three larger teeth, scarcely crenulate posteriorly. Antennal scape when folded back not reaching the occipital border; funiculi thick, all the joints except the first and last transverse, namely, 2-6 very short, 7 larger and together with the four last joints forming a 5-jointed club. Thoracic dorsum nearly straight, promesonotal suture distinct, mesoëpinotal suture obsolete: declivous surface of epinotum shining, abrupt, concave, acutely marginate on the sides. the angle be-

tween it and the base rounded; mesonotum and epinotum a little narrower than the pronotum. Petiolar scale seen from the side nearly straight anteriorly and posteriorly, above obliquely truncated, declivous posteriorly; seen from above semicircular or semilunar, that is convex anteriorly, subconcave posteriorly. Postpetiolar segment truncate anteriorly. Length 2 mm.

"Similar to the preceding but smaller, more opaque and with a differently shaped petiole.

"Friedrich-Wilhelmshafen (New Guinea, L. Biró)."

AMERICAN MUSEUM NOVITATES

Number 674

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Nov. 6, 1933

59.9,32 P (59.3)

A NEW FLYING SQUIRREL OF THE GENUS *PETAURISTA* FROM NORTHWESTERN SIAM

BY T. DONALD CARTER

Among a small collection of mammals received from Lt. Col. C. H. Stockley from northwestern Siam is a *Petaurista* closely allied to *Petaurista cineraceus* Blyth, but differing sufficiently in detail to warrant a new description.

Petaurista cineraceus stockleyi, new subspecies

TYPE.—No. 55836, Amer. Mus. Nat. Hist.; ♂, ad.; Melamoong, northwestern Siam, 2000 feet, altitude; March 11, 1933; collector, Lt. Col. C. H. Stockley. The type, procured from a native, is a skin without skull or measurements.

GENERAL CHARACTERS.—This animal closely resembles *Petaurista cineraceus* Blyth in size but is much darker and more richly colored than Burmese specimens in The American Museum of Natural History.

DESCRIPTION.—General color of the lower back gray, caused by the white banding of the black-tipped hairs, this banding continuing along the tail to within three inches of the tip which is black. Across the shoulders these white bands are replaced by Hay's russet (Ridgway), this color extending along the upper plane of the parachute. Occiput gray. Ring about eye, nose, and chin dark brown. Lower cheeks gray fading to white on the throat. Under parts white with a buffy wash on under plane of parachute becoming more intensified as it approaches the hind limbs. Forearms dark brown gradually darkening towards the extremities, the phalanges being black; the black extending along the lower surface of the arm and the edge of the parachute. The black is more extensive on the hind limbs, the entire foot being of that color, and extends along the edge of the membrane to the tail.

I take pleasure in naming this squirrel for Lt. Col. C. H. Stockley who has generously presented numerous specimens of Asiatic mammals to The American Museum of Natural History.

AMERICAN MUSEUM NOVITATES

Number 673

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Nov. 6, 1933

59.57,72 (7)

NEW NORTH AMERICAN DIPTERA

By C. H. CURRAN

The new flies described in the following pages have been found in collections forwarded for determination during the past few years and the descriptions are published at the present time in order that the material might be returned. Unless otherwise stated the types are in The American Museum of Natural History, and at least one type specimen of each of the species described is in this museum.

Coenomyidae

XYLOPHAGUS Meigen

The following key will separate the Nearctic species.

- 1.—Mesonotum wholly shining, without pollinose markings. *nitidus* Adams.
Mesonotum conspicuously pollinose on the disc. 2.
- 2.—Legs almost wholly black. 3.
Legs mostly reddish or yellowish. 5.
- 3.—First antennal segment relatively short and swollen. 4.
First antennal segment long and slender, the antennae as long as the width of the head. *longicornis* Loew.
- 4.—Upper half of the front cinereous pollinose. *laceyi*, n. sp.
Front shining except at the immediate vertex. *lugens* Loew.
- 5.—First antennal segment short, about twice as long as wide. 7.
First antennal segment elongate and slender, the antennae as long as the width of the head. 6.
- 6.—Front entirely shining black. *decora* Williston.
Front with a broad fascia of pale brownish pollen extending over the ocellar tubercle. *reflectens* Walker.
- 7.—Abdomen wholly black. 8.
Abdomen with two or more segments reddish. *fasciatus* Walker.
- 8.—Lateral margins of the mesonotum pollinose. *gracilis* Williston.
Lateral margins of the mesonotum wholly shining. 9.
- 9.—Front wholly shining. *lugens* Loew.
Front pollinose on upper half. 10.
- 10.—Mesonotum, from posterior view, with a narrow, median dark vitta in addition to the submedian vittae. *fasciatus* Walker.
Mesonotum without trace of median vitta, the submedian vittae evident from posterior view. *laceyi*, n. sp.

***Xylophagus laceyi*, new species**

Black, the legs of the female partly, of the male mostly yellowish. Length, 8.5 to 11.5 mm.

FEMALE.—Head shining black; an opaque black spot extending from the base of the antennae to the eyes, and immediately below this is a silvery-white spot on either side; front cinereous pollinose on a little more than the posterior half, the pollen somewhat darker behind the ocelli. Occiput with yellowish hair. Palpi large, black. Antennae black, the first segment about twice as long as wide.

Thorax shining black, the disc of the mesonotum cinereous pollinose, from posterior view with a pair of broadly separated darker vittae on the anterior half. Hair very pale yellowish. Disc of scutellum pale pollinose.

Legs black; anterior coxae, middle pair except basally, tips of posterior coxae, all the trochanters, tips of the femora, and broad bases of the tibiae, yellowish, the basal tarsal segment sometimes reddish yellow on the basal half or more.

Wings brown and whitish hyaline; first and second basal cells and a spot in front of the apex of the first basal, a broad preapical band, middle of the discal cell and of the two cells lying behind it, the middle of the anal cell and two or three spots and streaks in the auxillary cell, whitish hyaline. Squamae and halteres whitish yellow.

Abdomen shining black, the hair brown or black.

MALE.—Agrees with the female but the legs are pale. The legs are partly missing but the coxae are mostly pale yellow, the femora pale yellowish, with somewhat darker apices, the posterior pair broadly brown apically; tibiae yellowish with darker apices, the tarsi with the first segment mostly pale, the second pale basally. Abdomen with yellowish hair. Antennal base a little prominent.

Types.—Holotype, female, New Rochelle, N. Y., April 8, 1932 (Mrs. L. Lacey); allotype, male, Pelham, N. Y., April, 1931 (L. Lacey); paratype, female, Pelham, April 12, 1931 (L. Lacey).

X. laceyi is very similar in appearance to *lugens* Loew but the pollinose front separates it. The front is shaped as in *lugens* and it seems likely that the male will be readily distinguished from the male of *fasciata* by having a less prominent front. As I have no males of this latter species for comparison I can merely suggest that the difference probably exists.

It should be noted here that the record of *X. decora* Williston from Franconia, N. H., reported in Leonard's revision of the Rhagionidae, refers to *X. reflectens* Walker and I suspect that the Virginia record should be referred to the same species. I feel confident that *decora* is a strictly western species.

Bombyliidae***Bombylius canadensis*, new species**

Similar to *pygmaeus* Fabricius but with the proboscis one-third longer. Length, 8 to 10 mm. Proboscis in male, 8, in female, 7 mm.

MALE.—Head black, grayish pollinose; hair black, the soft hair tawny and

limited to the oral margin, the tomentose orbital tufts opposite the antennae wholly black; back of head with white hair, the occiput broadly tawny pilose behind the lowest fifth of the eyes. Antennae blackish, the third segment as long as the basal two combined, the first less than three times as long as the second. Palpi broad, black, black-haired.

Thorax dull black, the pleura brownish-gray pollinose; mesonotal hair whitish, the coarse hairs black, the sides very broadly white-haired in front of the suture and on the posterior calli, with tawny pile above the base of the wings; scutellum black-haired, the base broadly white tomentose. Pleura with tawny hair, the upper third with abundant black hairs intermixed and quite dark in appearance; infrasquamal hairs inclined to be whitish except basally, the squamal fringes tawny.

Legs reddish, the apical two tarsal segments black; femora black-haired, the posterior pair with short, black spines below.

Wings broadly brown in front to the apex of the first vein, thence much paler to the end of the second vein, hyaline behind and apically, with dark brown spots on the furcations, cross-veins and ends of the second and intercalary veins. Squamae brownish gray; halteres yellowish.

Abdomen black, the tip and venter dull reddish; tomentum reddish yellow, becoming white on the apical half; pile on the basal four segments long laterally, tawny, with black tufts on the sides of the second and third segments, the fourth almost wholly black laterally; dorsum with numerous, bristly black hairs; venter pale pilose except on the apical two segments; genitalia reddish.

FEMALE.—Front wide, with black bristly hairs and tawny tomentum, the face with some scattered tawny hairs. Mesonotal pile tawny, more yellowish on the disc, the black hairs not numerous. Short hair on the apical two-thirds of the scutellum tawny, a number of black, bristly hairs on either side; squamae with white fringe, the infrasquamal hair whiter. Abdominal tomentum tawny, the lateral black tufts smaller and less sharply limited.

Male, Thunder River, Quebec, June 25, 1930, in Canadian National Collection; female, Thunder River, June 27, 1930, in American Museum of Natural History. Both specimens were collected by W. J. Brown.

The region where these flies were taken is known as Quebec Labrador and lies north of the Gulf of St. Lawrence. The fauna is largely Arctic and many species known from Alaska are found in the region.

Empididae

***Rhamphomyia disconcerta* Curran**

CURRAN, 1930, Bull. Amer. Mus. Nat. Hist., LXI, p. 46.

Specimens secured recently differ somewhat from the types and I give a revised description. Length, 3 to 3.5 mm.

MALE.—Eyes narrowly separated, the front slightly narrower than the face; face and front cinereous-brown pollinose, quite bare except for the ocellar bristles; occipital cilia black, the hairs on the lower half of the occiput pale; occiput greenish-gray pollinose. Proboscis one-fifth longer than the head-height, black; palpi black. Antennae short, black, the third segment sub lanceolate, about twice as long as wide, the style very short.

Thorax greenish-gray or gray pollinose, the disc of the mesonotum tinged with brown on the posterior half; hair whitish, the acrosticals in a single row; two pairs of marginal scutellars; propleura with white hairs; infrascapular hair fine.

Legs black; second segment of front tarsi and the basal two segments of the posterior four tarsi pale yellowish with blackish tips. Hair whitish, black only on the apical tarsal segment; femora without bristles; middle tibiae with a dorsal row of four or five yellowish bristles, the posterior tibiae with two rows; tarsal segments with pair of long, pale bristly hairs at the tip.

Wings whitish, the costal veins yellow but becoming more or less brown on the apical half; stigma absent; the fourth vein stops well short of the costa but extends four-fifths the distance beyond the discal cell. Squamae and their fringe white. Halteres pale yellow.

Abdomen rather dull black above, the seventh segment, and sometimes the sixth, silvery white; the lateral margins and venter cinereous-white pollinose. Hair white, rather brownish and extremely short on the middle of the basal segments. Sternites simple. Genitalia rather small, normally directed posteriorly, the median lamellae moderately long and broad, with almost parallel sides on the apical half, the apex transverse but gently emarginate; upper lamellae projecting somewhat beyond the median and partly concealed; median lamellae with rather long white hairs, the upper pair with very short, fine hairs above.

FEMALE.—Front as wide as the ocellar triangle; third antennal segment less than one-half longer than wide; mesonotum brown with pale border; scutellum brownish; basal two segments of all the tarsi yellow, with brownish tips. Dorsum of the abdomen brown and with very short brown hairs, the apical segments with pale brownish pollen, the sides and venter with cinereous pollen except apically.

Three males and one female taken on flowers at Cold Spring Harbor, Long Island, on July 9, 1932 (Curran).

***Rhamphomyia ethellia*, new species**

Extremely like *bigelovi* Walley but in the male there is a row of bristly hairs on the basal half of the posteroventral surface and there are bristly hairs on the lower surface of the anterior femora instead of bristles. In the female the under surface of the femora bears abundant short black hair and entirely lacks bristles. Length, 6 to 7 mm.

MALE.—Eyes broadly contiguous above the antennae; face and front cinereous white pollinose, the oral margin broadly bare and shining black. Proboscis brown, twice as long as the head-height; palpi black. Antennae almost as long as the head-height, reddish, the third segment black, longer than the basal two segments combined, tapering, the style moderately long and brownish.

Thorax black, cinereous pollinose, the mesonotum with four broad black vittae, but these are obsolete in some views. Acrostical hairs in a single irregular row; scutellum with a pair of strong and one pair of weaker bristles; infrascapular hairs coarse and black.

Legs reddish, the tarsi black; apices of posterior femora narrowly blackish; anterior femora with a row of short, posteroventral hairs; middle femora with a row of short hairs on the anteroventral surface and a row of short bristles on the posteroventral surface; posterior femora with a row of anteroventral bristles and a row of

posteroventral hairs on the basal half; posterior tibiae with two rows of bristles above; middle tibiae with four or five short, fine bristles above and an incomplete row of very weak ones below.

Wings with yellowish-brown tinge, the stigmal area somewhat darkened; veins luteous, brown apically and in front; intercalary vein present. Squamae yellow, with black fringe; halteres yellow.

Abdomen pale rusty-reddish, shining, the sides and venter brownish, the apical segment somewhat darkened; hair black. Seventh sternite rather short, without long hairs; eighth sternite with several rather long hairs basally and with a few more arising between the lobes. Middle genital lamellae broad, tapering, the apex rounded below, sharply rounded above, bearing some coarse bristly hairs below and some finer, shorter ones on the apex; upper lamellae rather wide, gently tapering to the rounded apex, slightly more than twice as long as wide and about as long as the median lamellae, their upper edge with short hairs; filament long, sinuous on the apical half.

FEMALE.—Front cinereous pollinose, moderately wide, its sides parallel; an irregular row of short hairs toward either side; first antennal segment shorter than in the male. Anterior femora with a row of short hairs on the anteroventral surface; the posterior four femora with short, dense black hair below. Apical abdominal segments brownish, the lamellae as long as the fifth segment; venter somewhat reddish basally.

Types.—Holotype, male, allotype, female, Thunder River, Quebec, June 16, 1930 (W. J. Brown). Holotype in Canadian National collection; the allotype in American Museum of Natural History.

In the male of *bigelowi* Walley the seventh sternite is elongate and bears several bristles apically, there are bristles between the lobes of the eighth sternite and also on the lower part and apex of the median genital lamellae. The genital lamellae are reddish in *ethellia* and brown in *bigelowi*.

Neocota rufipes, new species

Differs from *weedii* Coquillett in having pale pile on the face and pleura, brownish-red legs and reddish genital lamellae. Length, 7 to 8 mm.

MALE.—Head cinereous pollinose, the face with yellowish tinge, the hair yellowish, black on the upper half of the occiput and along the posterior orbits to the lowest fourth of the eyes. Eyes almost touching above the antennae. Proboscis about as long as the head-height; palpi dull reddish, pale-haired. Antennae black, the third segment longer than the basal two combined, broad basally, tapering to the apex, the style tapering, as long as the width of the third segment; hair on basal segments pale.

Thorax black, cinereous-white pollinose, the mesonotum with a short reddish-brown stripe toward either side in front of the suture; mesonotal hair black, moderately abundant, the acrostical hair in two approximate rows; scutellum with a marginal row of about twelve black bristles; pleural pile pale.

Legs dull reddish, thinly cinereous pollinose, the coxae black in ground color; tarsi becoming brown apically; hair black, partly coarse, but there are no outstanding bristles; basal segment of anterior and posterior tarsi swollen and with long hair above, longer than the basal segment of the middle tarsi.

Wings with brownish tinge; stigma luteous. Squamae pale luteous, with very short, pale yellowish fringe; halteres reddish yellow.

Abdomen black, brown pollinose, in some lights appearing wholly or partly dull black; hair black, yellowish on the venter and genitalia, the venter, sides and apex of abdomen and the genitalia pale pollinose. Median genital lamellae reddish, with rather sparse, long, fine hair; upper lamellae blackish; filament reddish, robust, its apex hidden.

Types.—Holotype, male, Oklahoma Co., Oklahoma, March 22, 1931, (O. Sandol); paratype, male, Norman, Oklahoma, April 2, 1930 (P. Zeigler).

Syrphidae

Chrysogaster canadensis, new species

Related to *bigelovi* Curran but the thorax in both sexes is yellowish pilose and the front of the female bears yellow pile. Length, 7 to 7.5 mm.

MALE.—Head black; frontal triangle broad, rather strongly convex, black-haired; vertical triangle black-haired; occipital and facial pile pale yellowish. Face with very weak tubercle, more than the lateral third flat and with seven or eight low ridges; upper half of face thinly cinereous pollinose, the pollen produced triangularly downward in the middle and along the sides; oral margin prominent. Antennae brownish; third segment subrectangular, slightly wider than long; arista brownish.

Thorax black or bluish black, considerably dulled by black pollen, the pleura with pale pollen below. Pile dull yellowish; some black hairs above the roots of the wings, on the notopleura and on the anterior half of the mesopleura.

Legs black; hair black except basally on the femora.

Wings cinereous hyaline, sometimes with brown tinge; apical cell rather acute apically; veins yellowish basally. Squamae yellowish, with yellow fringe. Halteres yellow.

Abdomen black, the sides of the basal three segments broadly shining except posteriorly where the opaque black extends almost or quite to the lateral margins, the fourth segment shining, with a slender, incomplete, opaque black median vitta. Pile reddish yellow dorsally, becoming pale yellow on the sides, apex and venter. Venter cinereous pollinose, the pile very short and appressed. Genitalia shining, the pile pale yellow.

FEMALE.—Front moderately wide, the sides with four to six broad, irregular grooves; hair pale yellowish; sides of face only a little flattened, the tubercle entirely absent; pollen more extensive. Hair of thorax short, the black hair wholly absent. Knees reddish brown. Bases of wings conspicuously yellowish. Abdomen bronzed with the disc subopaque on the basal half although there is no sharp line of demarcation between the dull and metallic colors.

Types.—Holotype, male, Harrington Harbor, Quebec, June 30, 1929; allotype, female, Harrington Harbor, July 2, 1922. Paratypes: two females, Harrington Harbor, July 3, 1929, and one male, Thunder River, Quebec, June 14, 1930. All the specimens were collected by W. J. Brown and the types are in the Canadian National Collection.

Conopidae

Zodion bimacula, new species

Traces to couplet 11 in Van Duzee's key¹ but differs from both the included species in having the humeri shining black, etc. Length, 4.5 mm.

FEMALE.—Face, cheeks, and sides of the front on the lowest third, pale yellow in ground color, clothed with silvery-white pollen, the middle of the face shining yellowish. Front black, reddish on the anterior third, the ocellar triangle and vertical triangles along the orbits shining black. Occiput black, shining from most views but in some lights showing thin cinereous pollen. Hair black. Palpi brown. Antennae black, the second and third segments mostly reddish on the inner surface; second segment considerably longer than the third, the third rectangular, almost twice as long as wide, concave on the upper surface beyond the base of the arista, the lower apex sharply rounded; arista short, tapering, brown. Cheeks three-eighths as wide as the eye-height, without hair.

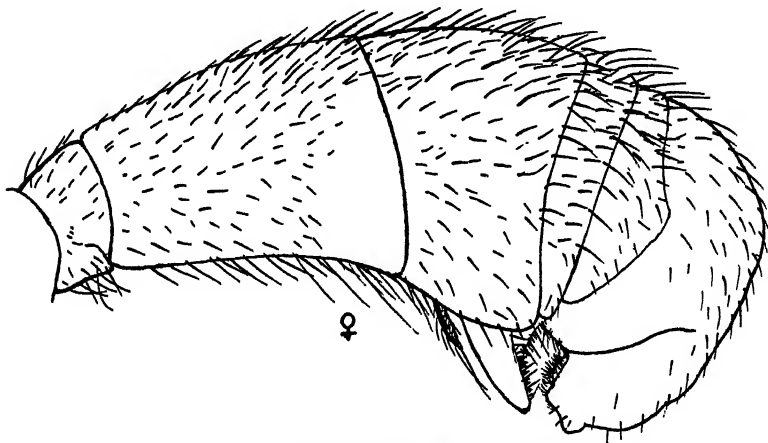


Fig. 1. *Zodion bimacula*, new species.

Thorax shining blackish; anterior fourth of the pleura, the sternopleura and an area above the posterior coxae cinereous-white pollinose; mesonotum inconspicuously brownish-gray pollinose on the disc; hair black, of moderate length. Scutellum with four bristly hairs on the margin and several short hairs on the disc.

Legs shining blackish, the tibiae and tarsi silvery pollinose above from some views; trochanters, tips of the femora, and the base of the middle tarsi reddish; broad base of the posterior femora and the broad bases of all the tibiae yellowish. Hair black, rather short.

Wings cinereous, the base broadly luteous; veins brown, the apical cell broadly open.

Abdomen shining black, the dorsum somewhat dulled by brownish pollen, the

¹Van Duzee, 1927, Proc. Calif. Acad. Sci., XVI, p. 589.

second segment with a large white pollinose spot on either side at the apex (the area shown without hairs in the figure). Hair black, rather short.

TYPE.—Female, Timagami, Ontario, Canada, September 2, 1932 (A. W. A. Brown).

Lauxaniidae

***Sapromyza browni*, new species**

Related to *annulata* Melander and *pictiventris* Malloch but distinguished from both by the shape of the male genitalia. The outer forceps are elongate as in *annulata* but are broader basally and more gradually tapering and the large claspers are slightly curved, with almost parallel sides and transverse at the apex with a small angular production at either apical corner. Length, 3.5 mm.

MALE.—Head yellow in ground color, cinereous pollinose; front with a pair of broad ferruginous-yellow median vittae, each of which is produced outward to form a narrow, lunate spot immediately above the base of the antennae; cheeks with a similarly colored spot in front extending from the eye to the oral margin. Proboscis reddish yellow; palpi dark brown. Antennae yellowish or rusty yellow, the arista rather brownish and distinctly pubescent.

Thorax pale in ground color, cinereous pollinose, the mesonotum with four broad, pale rusty-reddish vittae, the median pair parallel and extending over the scutellum almost to the apex, the outer pair slightly broader and more widely separated from the median pair than the latter are from each other; on the scutellum the dark vittae are more approximate. Four pairs of dorsocentrals, one situated in front of the suture; acrostical hairs in two rows.

Legs pale yellowish, all the femora with a rusty-brown spot on the under surface toward the apex, tip of the posterior femora brown in front, their tibiae with a brownish spot just beyond the basal fourth. Anterior femora with comb-like row of setulae before the apex.

Wings with luteous tinge. Squamae pale yellowish; halteres whitish yellow.

Abdomen pale yellowish, cinereous-yellow pollinose. the hairs and bristles arising from brownish spots. Genitalia reddish yellow.

FEMALE.—Differs only sexually.

TYPES.—Four specimens from Timagami, Ontario, Canada, collected by A. W. A. Brown: holotype, male, August 21, 1932; allotype, female, August 15, 1932; paratypes, two females, June 9 and August 15, 1932. The paratypes have been returned to Mr. Brown.

It is possible that this species will be found to show the same color variation as occurs in *annulata* and *pictiventris*, in which case the thorax may be rather dark in ground color and with brownish vittae and the abdomen more extensively brown.

Dryomyzidae

***Heterochella nudiseta*, new species**

Related to *H. buccata* Fallén, and similarly colored but the arista is practically bare and the third antennal segment usually only slightly darkened above. Length, 5 to 6.5 mm.

MALE.—Head reddish yellow in ground color, the occiput broadly brown above, the ocellar tubercle blackish; pollen yellowish, cinereous white on the upper half of the occiput, behind the eyes, along the frontal orbits and on the ocellar triangle. Normally three pairs of frontals, the anterior two pairs directed forward and outward, the others backward and more or less outward, but variable, three pairs sometimes outwardly proclinate, the number on the opposite sides sometimes differing; in front of the anterior orbitals a pair of rather weak interfrontals, the frontal hair coarse. Cheeks two-thirds as wide as the eye-height, haired on most of their surface. Facereceding, the clypeus prominent but not produced forward; antennal pits deep. Proboscis and palpi reddish yellow, the palpi with a bristle-like apical hair. Antennae reddish, the third segment a little longer than wide, more or less brownish above. Arista reddish brown, thickened on the basal fourth and almost bare. Eyes slightly oblique, almost round.

Thorax black in ground color, cinereous pollinose, the sides of the humeri, sides of propleura, an area below the base of the wings and the border of the scutellum more or less reddish. Seven to ten pairs of fine dorsocentrals; sternopleura with rather abundant coarse hair, without bristles. Scutellum with two pairs of marginals and several short hairs laterally.

Legs, including the coxae, reddish yellow, the hair long and black; bristles wholly absent, or hair-like except on the coxae.

Wings with hyaline or luteous tinge, somewhat darker along the costa, the cross-veins not distinctly clouded.

Abdomen reddish, slightly shining, in some lights with thin, whitish pollen on the dorsum; hair black, rather fine, long and abundant apically, less abundant basally. Genitalia reddish.

FEMALE.—Hair on mesosternum shorter, the upper edge with several bristly hairs and bristles; anterior femora with a row of weak bristles on the apical half of the posteroventral surface, the hair much shorter. Abdomen more shining, with shorter and less abundant hair. Apical valves of the ovipositor long and narrow, bearing fine, short hair.

TYPES.—Holotype, male, allotype, female, Boiler Bay, Oregon, January 31, 1931 (R. E. Dimick). Paratypes: eleven males, Boiler Bay, January 31, 1931 and March 9, 1930 (R. E. Dimick and J. Wilcox).

Muscidae

Coenosia canadensis, new species

Related to *rufibasis* Stein but the abdomen is entirely without dark spots. Length, 3 mm.

MALE.—Head black, thickly argenteous and cinereous pollinose, the front with yellowish tinge; frontal triangle not defined. Cheeks slightly wider than the antennae, the parafacials above about as wide as the cheeks, narrowing below. Palpi and proboscis blackish. Antennae extending to the oral margin, the apex rather sharply rounded above, the second and third segments densely argenteous pollinose; arista very short pubescent, thickened on the basal fourth.

Thorax black, cinereous pollinose, the disc of the mesonotum with slight brownish tinge, not vittate; acrostical hairs in a single, irregular row; apical scutellars slightly shorter than the basal, the scutellum with a pair of short bristly hairs on the disk.

Wings cinereous hyaline, with yellowish-tinged base; costa with short setulae; squamae white; halteres yellow.

Legs yellow, the basal half of the middle coxae and all but the apex of the posterior pair black in ground color; tarsi blackish. Anterior femora with a row of five or six posterior bristles; middle femora with two anteroventral and three posteroventral bristles on the basal half, a row of three widely spaced anterior bristles and a preapical posterior bristle; posterior femora with a row of five or six anteroventral and anterodorsal bristles, the rows rather irregular apically, the anteroventral bristles weaker basally, and with a single posterodorsal bristle situated before the apex. Anterior and middle tibiae each with one posterior bristle, the middle tibia with an anterior bristle near the middle; posterior tibiae with an anterodorsal bristle near the middle and a weak, anteroventral bristle beyond it. Posterior apical bristle of middle tibiae somewhat stronger than the anteroventral apical.

Abdomen black in ground color, cinereous pollinose, the disc with brownish tinge, but not at all spotted; lobes of fifth sternite with a row of short, fine bristly hairs. Genitalia blackish, cinereous pollinose.

Types.—Holotype, male, and paratype, male, Bradore Bay, Quebec, July 16, 1930 (W. J. Brown). The holotype is in the Canadian National Collection.

Tachinidae

Siphona tenuis, new species

Yellowish, the tarsi, the third antennal segment, and the arista, brownish. In my key to this genus,¹ considered under the name *Bucentes*, *tenuis* will trace to *brevirostris* Coquillett, since there is no trace of pollen on the abdomen, but the very long proboscis will serve to separate it. The length of the two apical sections of the proboscis taken together is equal to twice the head-height. Length, 5 mm.

Male.—Face, cheeks and lower half of the occiput whitish; front and upper half of the occiput yellow pollinose, the occiput mostly black in ground color on the upper half; two weak orbitals on either side, ocellars long; outer verticals strong; frontal vitta yellow, the front wider than either eye. Cheeks a little more than one-fifth as wide as the eye-height. Palpi elongate, very slightly swollen, bearing only two bristles below; proboscis very elongate, geniculate. Antennae with the third segment brownish except at the base, gradually widening from the base to near the apex, the lower apical corner broadly rounded, the upper corner acutely rounded, the segment somewhat less than three times as long as its greatest width; arista brownish with yellow base, the first segment short, the second about half as long as the third.

Thorax appearing whitish on the sides and venter, the dorsum ochraceous. Acrosticals, 3-3, dorsocentrals, 3-4; three sternopleurals; prosternum with a black hair on either side; scutellum with three pairs of strong marginals and a very weak apical pair.

Legs yellow, the tarsi blackish. Wings cinereous hyaline; third vein bristled to well beyond the anterior cross-vein, the first and fifth veins bare. Squamae with yellowish tinge, the halteres pale yellow.

Abdomen shining yellowish, the under surface very pale basally, the dorsum with indications of a rusty-yellowish median vitta. Discals absent; second segment with a pair of marginals, the third and fourth segments each with a row. The apex of the

¹1932, Amer. Mus. Novit. No. 534, p. 13.

abdomen is inclined to be slightly darker and there are dark stains on the sides of the third and fourth segments where the internal organs are in contact with the integument. However, the abdomen is normally wholly pale.

TYPE.—Male, Timagami, Ontario, Canada, August 1, 1932 (A. W. A. Brown).

Zenillia browni, new species

Traces to *blandita* Coquillett in the key by Aldrich and Webber¹ but is at once distinguished by the erect subapical scutellars and the shining black apices of the abdominal segments. Length, 5 mm.

FEMALE.—Front equal in width to the greatest width of either eye, gradually widening anteriorly; six pairs of frontals, the upper two reclinate, the lower two below the base of the antennae; two pairs of orbitals; ocellars strong; outer verticals half as long as the verticals; a row of black setulae behind the occipital cilia. Cheeks slightly more than one-fourth as wide as the eye-height; parafacials wide, with parallel sides on most of their length; facial depression moderately deep. Palpi reddish. Antennae rather large, the third segment obtuse apically, wider than the parafacials; second segment short; arista thickened on the basal half. Eyes with moderately abundant pile. Head with whitish pollen, the parafrontals cinereous, the frontal vitta dark brown.

Thorax black, cinereous pollinose, the disc of the mesonotum more or less brownish, bearing four black vittae, the median pair slender, lying just outside the acrosticals and extending only one-third the distance back of the suture; outer pair wider, interrupted at the suture and abbreviated in front and behind. Acrosticals and dorso-centrals, 3-3; posthumeral bristle absent; sternopleurals, 2-1; prosternum with black hairs laterally. Scutellum with three pairs of strong marginals, the apical pair absent but represented by a pair of erect subapicals.

Legs black, with thin cinereous pollen, the knees very narrowly yellow; middle tibiae with a single anterior bristle; anterior tibiae with two strong posterior bristles.

Wings cinereous hyaline; third vein with two bristles basally; costal spine short. Squamae white, with yellow rim. Halteres yellowish.

Abdomen black in ground color, cinereous pollinose, the first segment, apical third or slightly more of the second and third and the apex of the fourth, bare; second and third segments with indications of a bare median vitta. First and second segments each with a pair of marginals, the third and fourth each with a row; second and third segments with a pair of discals, the fourth with a row.

TYPE.—Female, Timagami, Ontario, Canada, June 6, 1932 (A. W. A. Brown).

AMERICAN MUSEUM NOVITATES

Number 675

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Nov. 25, 1933

59.57, 72 C (8)

THE AFRICAN SPECIES OF *CURTONOTUM* MACQUART (DROSOPHILIDAE; DIPTERA)

By C. H. CURRAN

The genus *Curtonotum* Macquart (*Cyrtionotum* of authors) is represented in Africa by six species, unless it is found that *quadrimalcula* Walker and *pictipennis* Thomson are identical or actually belong to a different genus. At least two of the species, *fuscipenne* Macquart and *albomacula*, new species, differ from the remaining species in lacking hair on the scutellum. I have attempted to elucidate the species said to belong to this genus but, unfortunately, the descriptions are not satisfactory as many essential characters were omitted by early authors, and only an examination of the types and the enumeration of these characters will definitely establish their systematic position. Since Malloch was quite familiar with *C. taeniatum* Fabricius, the type of the genus, it is safe to assume that his *striatifrons* has the scutellum haired, as it is entirely unlikely that he would have overlooked this character.

The types of the new species are deposited in The American Museum of Natural History.

TABLE OF SPECIES

- 1.—Wings dark brown; front and thorax vittate *fuscipenne* Macquart.
Wings pale brownish or cinereous 2.
- 2.—Wings with brown spots other than on the cross-veins 3.
Wings without brown spots other than on the cross-veins 4.
- 3.—Abdomen with black spots *pictipennis* Thomson.
Abdomen reddish, pale laterally *quadrimalcula* Walker.
- 4.—Front with a pair of entire, brown vittae dividing the front into three almost equal pale stripes *striatifrons* Malloch.
Front without brown vittae, usually dark above 5.
- 5.—Abdomen blackish with white pollinose spots *albomacula*, n. sp.
Abdomen yellowish, with brown spots or stripes *quinquevittata*, n. sp.

Curtonotum fuscipenne Macquart

Diastata fuscipenne MACQUART, 1843, 'Dipt. Exot.,' II, part 3, p. 260 (Fig.).

Female, Memehtown, Liberia, August 25 (J. Bequaert).

This specimen agrees with Macquart's description in most respects, but a great deal depends upon the interpretation of the word "étroites"

in reference to the brown mesonotal vittae. If the word is interpreted as meaning "narrow" my specimen cannot possibly be *fuscipenne*, but if it is interpreted as meaning "approximate" there is no doubt that the determination is correct except that my specimen has a slender median mesonotal vitta and the fifth abdominal segment bears a pair of white pollinose spots.

FEMALE.—Face white pollinose, the carina shining black except above; front brown, from anterior view reddish on the anterior half or more, with the orbits narrowly, a narrow median vitta and a pair of anteriorly converging vittae white pollinose; a single pair of strong frontal bristles, situated slightly in front of the anterior ocellus and a very weak hair in front of them on the pollinose stripe; ocellars strong; postocellars strongly convergent; verticals and outer verticals strong. Occiput brown pollinose above, whitish below; cheeks linear. Proboscis and palpi blackish. Antennae black, the second segment more or less brownish red; third segment tapering, hardly twice as long as wide; arista black, with long black rays, the base brownish.

Thorax black in ground color; mesonotum brown pollinose with three cinereous vittae, all wide on the anterior margin, but narrow and yellowish behind the suture, the middle one geminate except in front, the sides also broadly grayish; pleura gray pollinose. Scutellum wholly brown, with two pairs of strong and two pairs of weak marginals; two pairs of dorsocentrals; a single sternopleural with a few short hairs surrounding it.

Legs reddish, the coxae brown, with cinereous pollen; anterior femora with comb of tiny bristles apically.

Wings dark brown, slightly paler posteriorly; posterior cross-vein transverse Squamae reddish brown. Halteres pale yellow.

Abdomen black, brown pollinose, the fifth segment with a large pale pollinose spot on either side, the fourth with traces of similar spots.

Curtonotum quadrimacula Walker

Helomyza quadrimacula WALKER, 1849, 'List Dipt. Brit. Mus.,' IV, p. 1093.

Described from Sierra Leone.

I have not seen this species, but if it belongs to *Curtonotum* it should be readily recognized by the characters given in the key.

Curtonotum pictipennis Thomson

Geomyza pictipennis THOMSON, 1868, 'Eugenies Resa,' p. 598.

Described from Cape of Good Hope.

Apparently this species is very close to *quadrimacula*, and possibly identical with it. There is very little in the descriptions to indicate that there are two species concerned.

Curtonotum striatifrons Malloch

Cyrtotonotum striatifrons MALLOCH, 1930, Ann. Mag. Nat. Hist., VI, p. 325.

Described from Bahr el Ghazal, Sudan.

A very distinct species and readily recognized by the reddish and brown striped front.

Curtonotum albomacula, new species

Length, 3.25 to 4 mm.

MALE.—Face rather narrow, cinereous pollinose. Front slightly widening above, reddish, darker above, the frontal stripes ashy pollinose; anterior frontal bristle strong; ocellars long. The color of the front is somewhat variable from different views and the orbits are always narrowly pale pollinose. Occiput black, cinereous pollinose; face and cheeks yellowish in ground color, the facial grooves dark on the outer side. Palpi and proboscis blackish. Antennae reddish, the third segment mostly brown; arista black, with long black rays, the base broadly reddish.

Thorax blackish in ground color although the pleura may be more or less reddish. Mesonotum with yellowish pollen, but with a brown mottling and sometimes appearing mostly brown, the anterior and lateral borders more or less grayish; scutellum brownish with narrow yellow apical border, bearing two pairs of strong and two pairs of weak marginals; pleura whitish pollinose, the mesopleura more yellowish; in front with a brown spot immediately below the humeri and another above the front coxae. One strong sternopleural, the sternopleura rather evenly short-haired.

Legs yellow; coxae brown; anterior femora brown with reddish apex; middle femora usually with brown base, the posterior pair more or less extensively brown basally and with an obscure brownish band beyond the middle. Hair black.

Wings cinereous hyaline, the cross-veins more or less clouded with brown. Squamae yellowish. Halteres white.

Abdomen black, brown pollinose; first segment yellow, sometimes with a pale brown spot behind toward either side; second segment yellowish with the apical third black and a transverse brownish spot toward either side in front, third to fifth segments each with a pair of very large white pollinose spots on the dorsum and much larger spots on the under surface, the inner edges of the tergites black, the pale spots partly contiguous, that on the third segment partly yellowish in ground color and those on the venter mostly yellow beneath the pollen. Basal sternites yellow, the apical ones brown with yellow apices.

FEMALE.—Agrees with the male but the pale abdominal spots are somewhat smaller and the sternites are mostly yellow.

TYPES.—Holotype, male, allotype, female, Dande River, S. Rhodesia, July, 1933. Paratypes: two males and one female, Dande River, July, 1933; four females, Gurungwe, July, 1933 (A. Cuthbertson); female, Lenga Town, Liberia, August 15 1926, on human excrement (J. Bequaert).

Curtonotum quinquevittata, new species

Cyrtotonotum anus MALLOCH, 1930, Ann. Mag. Nat. Hist., VI, p. 327. (Not Meigen.)

While I have no authentic specimens of *anus* Meigen it is apparent from available descriptions that the species from Southern Rhodesia is

not Meigen's species. Malloch has already enumerated the principle characters of this species.

Length, 4 to 5 mm.

MALE.—Head yellow, the occiput black in ground color; front reddish yellow; the cinereous pollinose stripes extending to the anterior margin of the front or almost so, and broadly bordered with rusty reddish, the extremely narrow orbits white pollinose; anterior frontal bristle situated far forward; a tiny bristle inside the reclinate frontal or in front of it; ocellars strong; anterior half of front with tiny black hairs. Occiput grayish pollinose. Face and cheeks white pollinose. Proboscis reddish, the palpi brown. Antennae reddish, the third segment mostly brown; arista brown, with long black rays, more or less reddish basally.

Thorax mostly blackish in ground color, the scutellum, broad sides of the mesonotum, and middle of the pleura yellow; pollen cinereous white, cinereous on the mesonotum, the latter with four narrow reddish-brown vittae, the outer pair obscure and interrupted at the suture, the median pair represented on the scutellum by an incomplete median vitta. Two pairs of strong and two pairs of very weak marginal scutellars, the surface of the scutellum with coarse, appressed hairs. One strong sternopleural, one or two very weak bristles above, and scattered hairs, mostly arranged in a single row in front of the middle coxae.

Legs entirely yellow. Wings cinereous hyaline, the cross-veins lightly clouded with brown. Squamae yellow. Halteres white.

Abdomen pale reddish, clothed with yellowish pollen, with three rows of brown spots above and two below. Dorsum with a broad median brown vitta extending from the base of the third segment to the apex of the abdomen, narrowly interrupted at the apices of the segments; the second to fourth segments each with a slightly oblique, broad, transverse brown spot on either side, those on the second and third segments produced forward in the middle almost to the base of the segment; on the under surface the tergites each have a brown basal spot on the lateral margins, those on the second and third segments more or less oval, the others triangular and tapering to the apex. Sternites reddish yellow, the fifth black. Genitalia reddish.

FEMALE.—The fine frontal hair is a little more conspicuous and the brown lateral spots on the fifth abdominal segment extend forward in the middle.

TYPES.—Holotype, male, allotype, female, Lomagundi, S. Rhodesia, December, 1928. **PARATYPES:** four females, Lomagundi, December, 1928 (A. Cuthbertson); male and female, Lourenco Marques, January–March, 1914 (H. A. Junod).

This species differs from the other African species that I have seen in possessing hair on the scutellum. This character is not mentioned in available descriptions, hence I am unable to determine whether this is the only species having the scutellum haired.

59.57,71 A (7)

THE NORTH AMERICAN SPECIES OF *ANOROSTOMA* LOEW
(HELOMYZIDAE; DIPTERA)

BY C. H. CURRAN

ANOROSTOMA Loew

In American Museum Novitates No. 526 I gave a key to the species of *Anorostoma* but this, unfortunately, did not include all of the described species. In 1927, Abt. Leander Czerny¹ published a revised key to the genus, but in this case also some species were omitted. In my key, *jerseyi*, *coloradensis*, and *currani*, all described by Mr. C. B. D. Garrett, were omitted, while Abt. Czerny omitted *alternans* and *hinei* Garrett. After reading the descriptions and comparing them with specimens in the museum collection I find myself unable to identify positively several of the species described by Mr. Garrett, as the data given is too meager. Garrett failed to recognize *marginata* Loew and described the species again as *coloradensis*. It is obvious that several species have been confused under the name *marginata*, but they cannot be definitely separated by means of Garrett's descriptions. Several of the characters used by Garrett are variable, but to what extent this is true I cannot say. The length of the anterior frontal bristle is not absolutely constant, the mesopleural vitta varies in width and may be obsolete posteriorly, the number of sternopleurals is not constant and species that normally have two or more may have only one, while the hairs on the sternopleura vary. However, all of these characters have some value and I have used them in the key because they furnish the only indication of the identity of Garrett's species.

It is obvious that the correct identification of several of the species described by Garrett must await a careful examination of the types. My identifications of several of the species can be considered only as tentative, but I present as much information as I can in order that some one may be able to correct any errors.

¹Konowia, VI, p. 58.

TABLE OF SPECIES

- 1.—Wings whitish, with many brown and grayish spots. 2.
Wings not whitish, the dark markings limited to the cross-veins and apex of the
auxiliary vein. 4.
- 2.—A black spot from the base of the antennae to the eye. 3.
No such spot, rarely a rusty-reddish spot visible in some lights; frontals weak,
not arising from dark spots. *cinereum* Curran.
- 3.—Mesonotum with four, the pleura with one brownish vitta. *opacum* Coquillett.
Mesonotum and pleura without vitta. *maculatum* Darlington.
- 4.—Abdomen yellowish red, without pollen; usually two or three strong sterno-
pleurals. *alternans* Garrett.
Abdomen pollinose, never slightly shining. 5.
- 5.—Mesonotum with very numerous brown spots, the disc appearing quite brown;
sternopleura normally with two or more pairs of strong bristles. 6.
Mesonotum cinereous or yellowish, at most the bristles arising from brown spots,
the hairs rarely arising from rusty-reddish spots; only one strong sterno-
pleural. 7.
- 6.—Front brownish; posterior femora with a blackish spot toward the apex; pul-
villi dirty white. *grande* Darlington.
Front reddish; posterior femora wholly reddish; pulvilli yellowish. *wilcoxi*, n. sp.
- 7.—Mesopleura with a very broad rusty-reddish vitta above which extends to the
upper margin. 11.
Mesopleura rarely somewhat darkened above, never with a broad vitta extending
to the upper margin. 8.
- 8.—Mesopleura dark below; cross-veins with blackish clouds. *curranii* Garrett.
Mesopleura either with a dark vitta above, separated from the upper edge, or
wholly pale, never darkened below; cross-veins with pale clouds. 9.
- 9.—Sternopleura with a single row of hairs along the middle. *jersei* Garrett.
Sternopleura with two rows of hairs down the middle. 10.
- 10.—Acrostical hairs in a single, irregular row, the hairs of the mesonotum very
sparse; front with white pollen above. *carbona*, n. sp.
Acrostical hairs in two rows and with additional scattered hairs between the
dorsocentrals, the mesonotal hairs moderately numerous; front with cinere-
ous-yellow pollen on upper half and only a little white pollen laterally.
marginata Loew.
- 11.—Two rows of hairs down the middle of the sternopleura. *hinei* Garrett.
A single row of hairs down the middle of the sternopleura. *lutescens*, n. sp.

Anorostoma cinereum Curran

CURRAN, 1932, Amer. Mus. Novit., No. 526, p. 10 (f).

In addition to the type series I have before me six males and five females taken at Boiler Bay, Oregon, on May 18, 1930. Type in American Museum of Natural History.

In the original description it was stated that the bristles of the thorax did not arise from black spots and this is true in most cases.

However, some specimens have distinct black or brown spots at the bases of the mesonotal bristles, but none have black spots on the front, and the frontal bristles are weaker than in allied forms. The gray wing-spots are less numerous than in the other species also but there is some variation in their extent.

Anorostoma maculatum Darlington

DARLINGTON, 1908, Trans. Amer. Ent. Soc., XXXIV, p. 76.

CZERNY, 1924, Abh. zool.-bot. Gessellsch., Wien, XV, p. 115.

Darlington described this species from a large series taken by Dr. Aldrich at Pacific Grove, California, on May 9. I have before me one male, Monterey Co., California, July 5, 1896 (Wheeler Collection). Type in U. S. National Museum.

In general appearance *maculatum* is very similar to the more northern *cinereum* but the presence of the black frontal spots, stronger frontal bristles and the black spot between the antennae and eye are characteristic.

Anorostoma opacum Coquillett

COQUILLET, 1901, Proc. U. S. Nat. Mus., XXIII, p. 614.

CZERNY, 1924, Abh. zool.-bot. Gessellsch., Wien, XV, p. 114.

I have not seen this species but it is very distinct from the two foregoing. The head is as in *maculatum* but the mesonotum bears four and the pleura a single brown vitta and the wings are more spotted. The species was described from a single female from Los Angeles Co., California. Type in U. S. National Museum.

Anorostoma alternans Garrett

GARRETT, 1925, 'Seventy New Diptera,' p. 4.

Described from Normal, Washington, May, the type in the Garrett Collection. Three females from Boiler Bay, Oregon, May 18, 1930 (J. Wilcox).

This species is readily recognized by its black, cinereous pollinose thorax and the rusty-reddish, non-pollinose abdomen. In the specimens before me the number of sternopleurals varies from one to three. The wings have a strong luteous tinge, with the cross-veins clouded with brown.

Anorostoma grande Darlington

DARLINGTON, 1908, Trans. Amer. Ent. Soc., XXXIV, p. 75.

CZERNY, 1924, Abh. zool.-bot. Gesellsch., XV, p. 113.

Originally described from a single male from Pacific Grove, California, May 9. Type in U. S. National Museum.

The species is unknown to me but is very similar to the following. It may be that *A. wilcoxi* is the same but none of my specimens agree with Darlington's description.

***Anorostoma wilcoxi*, new species**

A large brownish looking species, the abdomen black with cinereous pollen, the genitalia reddish; sternopleura with from one to four strong bristles. Length, 5.5 to 7 mm.

MALE.—Face and cheeks yellowish, whitish pollinose; front reddish, becoming yellow in front, the pollen brownish yellow near the ocelli; anterior frontals about half as long as the posterior pair; ocellars long; frontal hair black, limited to the anterior half of the front where it is moderately abundant; occiput black behind the eyes, cinereous pollinose, the hair coarse and black. Cheeks almost as wide as the eye-height, with a row of bristly hairs below; vibrissae strong; palpi yellow, with sparse, short bristles. Antennae reddish, the third segment short oval; arista brown, with paler area just beyond the thickened base. Eyes longitudinally oval; a darkened spot along the orbit between the face and front.

Thorax apparently dark in ground color; pleura and pectus cinereous pollinose, the mesopleura broadly yellowish brown above. Mesonotum cinereous pollinose but each hair arises from a brown spot so that the disc of the mesonotum appears yellowish brown; the bristles each arise from a blackish spot. Scutellum cinereous pollinose, the bristles arising from large brown spots; the brown spots may be connected, leaving the middle and narrow sides of the scutellum cinereous. Behind the propleural bristle there may be a bristle and one or two hairs, or only three or four hairs. Sternopleura with from one to four bristles and with numerous, moderately long hairs in the middle.

Legs reddish, cinereous pollinose, the anterior femora sometimes dark in ground color. Anterior femora with two partial rows of bristles posterodorsally, with long hairs ventrally and with a row of rather weak ventral bristles that become hair-like and sparse toward the base; middle femora with two anterior bristles beyond the middle and a row of four to six weaker bristles above them, ventrally with long black hair on the basal half, the apical half with a row of short, stout posteroventral bristles; posterior femora with moderately long hair below and two irregular rows of anterodorsal bristles on the apical half. Middle tibiae with three strong apical bristles and five weak ones; posterior tibiae with soft, short hair ventrally and with a single apical bristle situated posteroventrally. First segment of the posterior tarsi somewhat swollen, not or scarcely longer than the second segment, on the apex of the under surface toward the posterior edge with a very short, stout curved black spine.

Wings with strong luteous tinge, the cross-veins and apex of the auxiliary vein strongly clouded with brown; veins yellowish and brown; in some lights the wings show white spots in the apical cell beyond the anterior cross-vein, in the first basal before the anterior cross-vein and just beyond the anal cell. Squamae and halteres yellow.

Abdomen black, thickly cinereous pollinose, the segments each with two to four marginals laterally, the row on the fifth segment almost complete. Genitalia reddish, with cinereous-yellow pollen, the basal dorsal plate black in ground color and with

very short hairs above in the apical part; hair on the genitalia almost as long as the upper plate. Venter dark, cinereous pollinose.

FEMALE.—Front and middle femora with shorter hair below, the middle pair with three bristly hairs on the basal third; first segment of the posterior tarsi as long as the following two segments combined, without curved spine at apex but with two short bristles. Fifth abdominal segment more or less brownish red, the following segments reddish; ovipositor with several short spines above.

TYPES.—Holotype, male, allotype, female, Boiler Bay, Oregon, March 30, 1930. Paratypes: eleven males and three females, Boiler Bay, March 9, 30, and May 18, 1930, all collected by J. Wilcox, and one male, Corvallis, Oregon, April 1, 1930, collected by Itel Wilcox.

In *grande* Darlington the front is described as brown, the antennae brown, the mesonotum light brown with darker brown spots, the scutellum reddish brown, and the posterior femora exceptionally stout.

Anorostoma currani Garrett

GARRETT, 1922, *Ins. Ins. Mens.*, X, p. 176.

CZERNY, 1927, *Konowia*, VI, p. 37.

Described from a single male collected by Dr. A. J. Hunter at Teulon, Manitoba, Canada, August 28, 1920. Type in Garrett Collection.

This species is wholly yellowish, the mesonotum with only a few short black hairs and the pleura darkened below. The anterior frontal bristle is about one-third as long as the posterior frontal. Genitalia with long and abundant hairs. Posterior femora with a row of bristles below. Cross-veins clouded with brown.

The significant facts in the description are mentioned above and the presence of distinct bristles on the posterior femora is distinctive. One or two of the species have short bristly hairs toward the apex of the anteroventral surface but these are not conspicuous.

Anorostoma jersey Garrett

GARRETT, 1924, *Ins. Ins. Mens.*, XII, p. 29.

A. jerseyae CZERNY, 1927, *Konowia*, VI, p. 37.

It seems to be impossible to recognize this species from the description. It is compared with *coloradensis* Garrett (*marginata* Loew) and appears to be nothing more than a large specimen of that species. Garrett states that the hypopygium is on a slide. There is apparently a rather narrow rusty-brownish vitta near the upper edge of the mesopleura but this character is variable in *marginata*. The presence of only a single row of hairs down the middle of the sternopleura, more hairy mesonotum, etc., are characters given by the author for the separation of this species from *coloradensis*.

Anorostoma marginata Loew

LOEW, 1862, Berl. Ent. Zeitschr., p. 243.

A. coloradensis GARRETT, 1924, Ins. Ins. Mens., XII, p. 28.

A. coloradiniense CZERNY, 1927, Konowia, VI, p. 37.

I have before me more than thirty specimens of this species. Most of them are from Pagosa Springs, Colorado, while some are from Bra-dore Bay, Quebec, Canada. The types of *coloradensis* are apparently in the Garrett Collection.

Three of my Colorado specimens are apparently from the same lot as Garrett's types and I have seen others in the collection of the University of Colorado bearing similar numbers. The numbers refer to cages in which experiments were being conducted and the specimens were distributed several years ago. Loew's description of *marginata* agrees perfectly with the specimens before me, except that the abdomen is blackish or brownish in ground color although in some specimens it does not appear to be much darker than the mesonotum, so dense is the pollen.

Owing to the uncertainty regarding the identity of *marginata* I have delayed the publication of this paper for several months and am now able to establish as a fact the suspected synonymy of *coloradensis*. Loew described *marginata* from two males and one female, and these specimens are now in the Museum of Comparative Zoölogy. All three are unusually light-colored specimens and the males are unusual in that they have only a broad, incomplete median vitta on the mesonotum black in ground color, while the abdomen also bears a broad black median vitta. The sternites are wholly yellowish. None of my specimens will exactly match the types, but one male comes very close while a few approach the male types in color. Most male specimens have the mesonotum mainly black in ground color and the abdomen mostly black, but the females are much more extensively pale.

In the large series taken at the same time in Colorado I find a good deal of variation. The distance between the frontal bristles varies somewhat and so does the length of the anterior one, while in one specimen the anterior frontals are absent. In some specimens there is only a single row of hairs down the middle of the sternopleura, in others two rows, while in some there is one row on one side and two on the other. The dark vitta toward the upper border of the mesonotum may be entire or it may be obsolete on the posterior half or more, and there is variation in regard to the bristles on the upper surface of the anterior femora.

The description of *carbona*, new species, will apply fairly well to the specimens referred to this species but in *marginata* there are two rows of

acrostical hairs with many additional scattered ones between the dorso-centrals; the basal portion of the genitalia is much smaller so that much more of the following section is visible from dorsal view and there are no long hairs on the middle tibiae. In the females the abdomen is sometimes mostly reddish yellow in ground color.

Anorostoma carbona, new species

Blackish, thickly cinereous pollinose, the head, legs and genitalia reddish or yellowish in ground color. Length, 5 mm.

MALE.—Face and cheeks yellowish, with whitish pollen; front reddish, paler anteriorly, the anterior frontals hardly half as long as the posterior pair; ocellars long; occiput with only two or three hairs on either side just above the neck; cheeks half as wide as the eye-height, with a row of hairs below; vibrissae rather fine. Palpi yellow, with short, black, bristly hairs. Antennae reddish, the third segment obtusely oval; arista reddish brown.

Thorax black in ground color, the humeri, scutellum and the broad anterior border of the pleura yellowish. Mesonotal hairs very sparse, only a single irregular row between the dorsocentrals, although there may be one or two paired hairs, the hairs arising from small brown spots. One or two very short hairs behind the propleural bristle; one sternopleural and only a single row of hairs along the middle of the sternopleura.

Legs reddish yellow; anterior coxae with at most a row of short hairs on the anterior surface in addition to the bristles. Anterior femora with a row of very fine posteroventral bristles, a few long hairs below and a row of dorsal bristles with only two or three fine, short bristles behind; middle femora without distinct bristles below but with a row of long hairs and some additional long hairs toward the base; posterior femora without bristles below but with fairly long hairs laterally, on the dorsal surface with a row of four or five bristles toward the anterior surface on the apical half and one dorsal bristle. Middle tibiae with moderately long hair posteriorly toward the apex and with three strong and five weak apical bristles. Basal segment of the posterior tarsi a little longer than the second, the short apical spine rusty reddish.

Wings with grayish tinge, the cross-veins faintly clouded, the usual whitish spot present adjacent to the anal cross-vein. Squamae cinereous white, the halteres yellow.

Abdomen blackish in ground color, cinereous pollinose, the second to fourth segments with marginals only laterally, the fifth with an apical row; apices of the segments yellow. Genitalia reddish yellow, the basal section very large when seen from above, almost equal to the visible portion of the following section, and bearing very few tiny hairs; hair on genitalia moderately long but not abundant.

Types.—Holotype and three paratypes (males) from Carbon Co., Wyoming.

This species is very similar in appearance to *marginata* Loew, but the presence of so few mesonotal hairs and the unusually large basal section of the genitalia will at once separate *carbona* from that species.

Anorostoma hinei Garrett

GARRETT, 1925, 'Seventy New Diptera,' p. 4.

Described from a number of females from Alaska, collected by Dr. Hine during July and August. Types in Ohio State Museum and Garrett Collection. I have a single female from Arizona, Bear Wallow, Santa Catalina Mts., July 12-17, 1916 (F. E. Lutz), that agrees perfectly with the description.

This form agrees with the preceding, differing only in having the brownish stripe on the mesopleura wider and only very narrowly separated from the upper edge on the posterior half. I do not think it is anything more than a color form of *marginata*.

Anorostoma lutescens, new species

Reddish yellow in ground color and thickly pollinose; hairs of the mesonotum arising from rusty-reddish spots. Length, 6 mm.

MALE.—Face and cheeks yellow in ground color, white pollinose; front reddish, broadly darker across the vertex; anterior frontal bristles hardly half as long as the posterior pair; ocellars long; hairs on the occiput near the neck abundant; cheeks two-thirds as wide as the eye-height, with two hairs below on either side; vibrissae slender. Palpi yellow, with black bristly hairs below. Antennae reddish; third segment short oval; arista brown, pubescent.

Mesonotum cinereous-yellow pollinose, the hairs numerous and arising from rusty-reddish spots; in the middle with a pair of rusty-reddish vittae which are fused in the middle and not regularly separated anteriorly, slightly diverging and broadened posteriorly and extending over the scutellum which is broadly yellow in the middle and narrowly so on the sides and apex. Between the dorsocentrals the hairs are arranged in six irregular rows. Behind the propleural bristle a single hair; one sternopleural bristle; on one side a single row of hairs down the middle of the sternopleura, on the other, a complete row and a partial second.

Legs reddish; anterior coxae with very few hairs on the anterior surface except at the apex; anterior femora with a row of posteroventral bristles, those on the basal two-thirds hairlike, the hair rather short, on the upper surface with a row of bristles and behind these a second, incomplete row of short, weak bristles; middle femora with rather long hair on the basal half and with a row of posteroventral bristles which are hairlike on the basal half; posterior femora with rather abundant hair below, a row of hairs on the apical third of the anteroventral surface slightly longer and bristle-like, three near the base of the posteroventral surface about twice as long as the rest of the hair, on the apical half of the upper surface toward the anterior side with five or six bristles arranged in two rows; middle tibiae with three strong and five weak apical bristles; first segment of the posterior tarsi a little longer than the second, the apical curved spine yellow with a black tip.

Wings with grayish tinge, the apex of the auxiliary vein and the cross-veins with dark brown clouds, that on the posterior cross-vein less distinct; beyond the anal cell a white spot. Squamae and halteres yellow.

Abdomen wholly pale; marginal bristles moderately long, absent on the middle of the segments. Genitalia paler than the abdomen, the hair rather sparse.

TYPE.—Male, Boiler Bay, Oregon, May 18, 1930 (J. Wilcox).

This species is rather similar to *currani* but it is evidently separable by the color of the thorax and by having coarser sparse hair on the hypopygium.

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THE SPERMACETI ORGAN AND NASAL PASSAGES OF THE
SPERM WHALE (*PHYSETER CATODON*) AND OTHER
ODONTOCETES

BY H. C. RAVEN AND WILLIAM K. GREGORY

INTRODUCTION

On the thirteenth of March 1928, a young male sperm whale, *Physeter catodon*, measuring eighteen feet three and one-half inches in length to the notch of the flukes, strayed into New York harbor. It was captured by longshoremen who towed it into the Gowanus Canal of Brooklyn, where it soon died. It is interesting to note that another young sperm whale sixteen feet long was taken in Vineyard Sound, about fifteen miles from New Bedford on the twenty-ninth of March 1842 (Jackson, 1847). The specimen taken in New York harbor was purchased from its captors by The American Museum of Natural History and brought entire on a motor truck to the museum. It was then my privilege (H. C. Raven) to dissect and study this extremely interesting animal. Of special importance were the highly specialized and hitherto little explored nasal passages and the spermaceti organ that is intimately related to them.

Pouchet and Beauregard (1885), Benham (1901), and Kernan and Schulte (1918), the able anatomists who have described the spermaceti organ and nasal passages of either *Physeter* or *Kogia*, have left us a bewildering mass of details with but indefinite clues as to the functions, origin or evolution of the several parts. It was only after repeated comparisons of the precise description by Kernan and Schulte of the anatomy of the nasal organs of a foetal *Kogia*, with the conditions recorded by one of us (H. C. Raven) in the young *Physeter*, that we began to be able to identify with any degree of confidence the probable homologies of the several parts in these two genera and were finally able to compare them effectively with the less specialized conditions in other odontocetes. In the present paper, we shall begin, therefore, with a brief summary of what has already been shown, by Abel and others, as to the origin and evolution of the highly peculiar nasal organs of the lower odontocetes; then we shall pass to a very brief description of the spermaceti organ, the spiracular sacs, and nasal passages of our specimen, stressing the

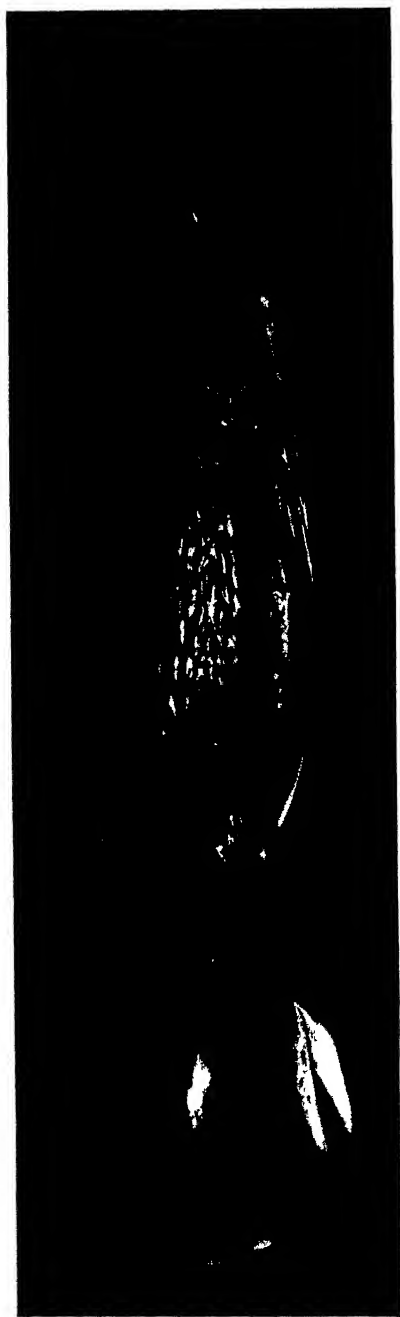


Fig. 1. *Physeter catodon*. Photograph of model of young specimen described in text.

evolutional and functional aspects of the parts noted in the dissection. This will lead first to an attempt to identify and equate the homologous parts in *Physeter* and *Kogia*, in the form of a convenient tabular summary, and finally to a discussion of the phylogenetic relationships of these two genera with each other and with the known fossil physeteroid genera of Miocene times.

EVOLUTION OF THE NASAL REGION IN ODONTOCETES

Probably whalers have seldom, if ever, suspected that all that part of the huge bow-like head of the sperm whale that contains the "case" and its precious contents—the spermaceti oil—is nothing more nor less than a titanic nose, the greatest nose on record. Nor have anatomists deigned to use such a simple concept in their highly technical descriptions. However, thanks to the illuminating works of Abel (1902) and Kellogg (1928), we can now view the anatomy of the nasal region of the sperm whales in the light of the general evolutionary history of the order as a whole. To begin with, we are met with the objections of Gidley (1913) and Miller (1923) that the archaeocetes of the Eocene and Lower Oligocene were not ancestral whales. While this is doubtless true of the excessively specialized *Zeuglodon* and its near relatives, yet the skull of *Protocetus atavus* Fraas (1904), of the Lower Oligocene, although perhaps too late in time, points the way unmistakably toward the curious relations of the bones of the snout in both orders of whales.

Miller (1923) attributes the backward growth and displacement of the premaxillae and maxillae of odontocetes upon the top of the head to a kind of "telescoping" or sliding movement due to the pressure of the water upon the forwardly moving head, but it seems to us much nearer to the facts to associate it with the backward displacement of the nose (Figs. 2, 3) and the progressive acceleration and increase of this organ in earlier and earlier foetal stages. Indeed, Abel (1902) has very clearly shown that, as the upper jaw grew forward into a fish-catching rostrum (a type of muzzle that again and again has been evolved in marine vertebrates), the nose retreated to the top of the head, forcing back, as it were, the nasal bones, but supported beneath by the backwardly growing flanges of the premaxillae and maxillae which finally reached to the occipital crest. Meanwhile, doubtless in connection with progressively deeper diving habits, while the nasal cavities became hypertrophied into two or more distensible sacs, the nasal muscles that close and open the nostrils became greatly enlarged. Asymmetries also were developing, accompanied perhaps by regional and functional differentiations, so that

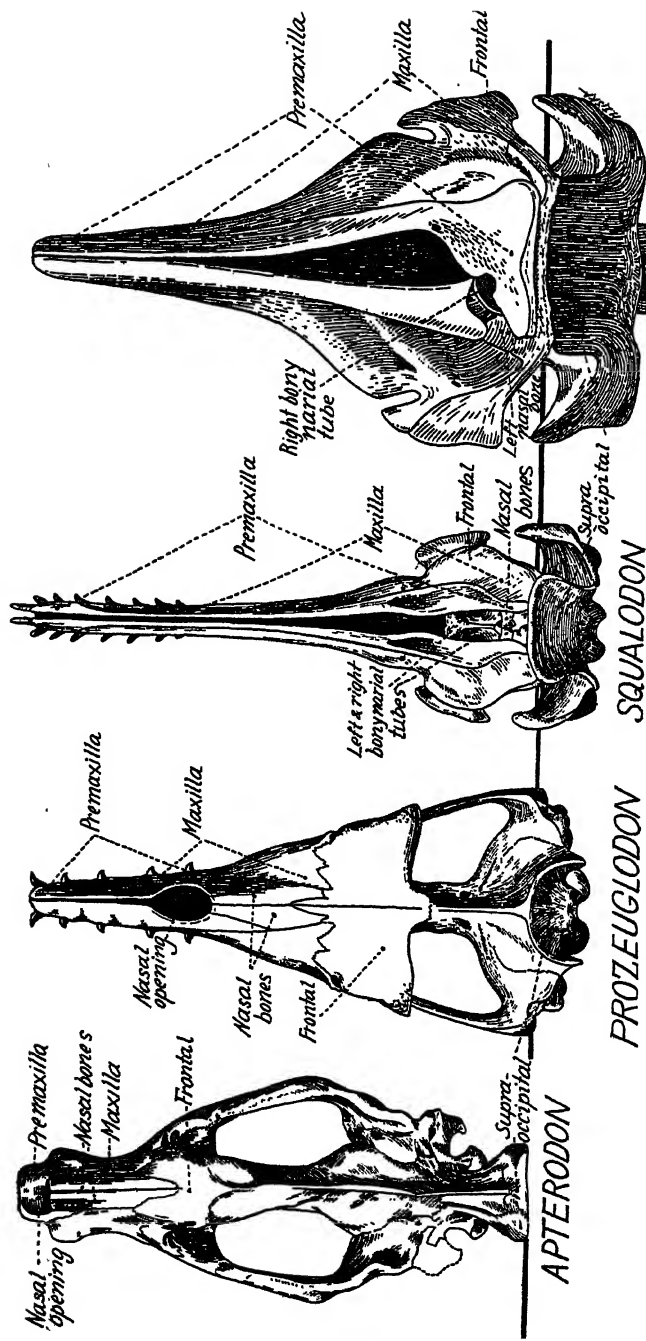


Fig. 2. Retreat of the nostrils and correlated specializations of the rostrum and skull-top in odontocetes.
All figures reduced to uniform length from premaxillary tip to occipital crest.

Semi-aquatic hyaenodont, *Apterodon*, Lower Oligocene, Fayûm, Egypt. After Osborn.

Primitive archaocete, *Prozeuglodon atrox*, Lower Middle Eocene, Fayûm, Egypt. After Fraas.

Squalodon cabertensis, Middle Miocene, Maryland. After Kellogg.

Diaphorocetus poucheti, Lower Miocene, Patagonia. After Kellogg.

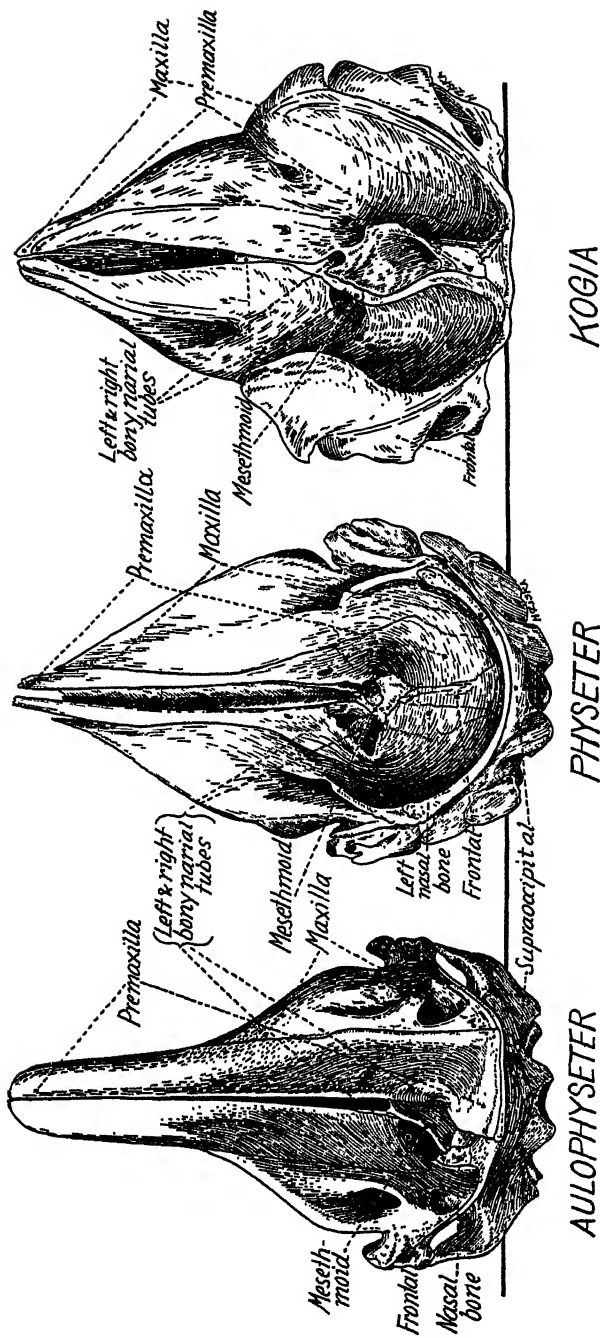


Fig. 3. *Aulophyseter morricei*, Middle Miocene, California. After Kellogg.
Physeter catodon. Skull of young specimen described in text.
Kogia breviceps. Skull of young specimen described by Schulte.

finally (in *Kogia*) the left bony narial tube (Fig. 3) became several times larger than the right, while in *Physeter* the right respiratory sac greatly predominated over the left (Fig. 4). The marks of these changes in the soft parts are impressed upon the bones that support them, so that we can very plainly see that even in *Diaphorocetus poucheti* (Fig. 2) of the Lower Miocene of Patagonia, which Kellogg figures as an early member of the sperm whale group, the great nasal turret, enclosed in a huge capsule of nasal muscles and stream-lined by surrounding adipose tissue, was already in existence. But, it may be noted at this point, this great nose was never a smelling organ, the olfactory parts of the skull having long since become atrophied. It was rather a gigantic organ for the forceful exhalation and inhalation of air, after and before long periods of submergence under high pressure.

EVOLUTION OF THE SPERMACETI ORGAN

We regard the spermaceti organ as merely a specialized central portion of the nose, reaching its highest development in the sperm whales but plainly foreshadowed in other odontocetes. In *Physeter* (Figs. 4-6) it is a sac-like mass of areolar tissue usually filled with oil and enclosed in a tough, muscular, fibrous sheath, occupying almost the entire upper part of the rostrum beneath the skin. We infer that its main function is to act as a force-pump for the bony narial passages, drawing a great quantity of air into the respiratory sacs and perhaps preventing the escape of air under the pressures of great depths. It may possibly also act in part as a hydrostatic organ, since by severe contractions of part of its muscular sheath the contained oil might be squeezed toward one end or the other, while the air sacs were being inflated, thus lightening the specific gravity of that end and tending to alter the direction of motion of the animal.

The beginning or at least a relatively early stage in the evolution of a spermaceti organ may, we conclude, be seen in other odontocetes, such as the narwhal (Fig. 7). In the American Museum Greenland Expedition of 1926, one of us (H. C. Raven) obtained an adult narwhal and made serial parasagittal sections of the frozen head. Figure 7 shows, above the bony rostrum, a mass of muscular, connective and fatty tissue enclosed in a muscular fibrous sheath that represents an early stage of the case of the sperm whale. Beneath the thick fibrous skin, this case is enwrapped with powerful nasal muscles, both transverse and oblique. The contraction of some of these would force the back part of the case into the left and right bony narial tubes and close the spiracular sacs and

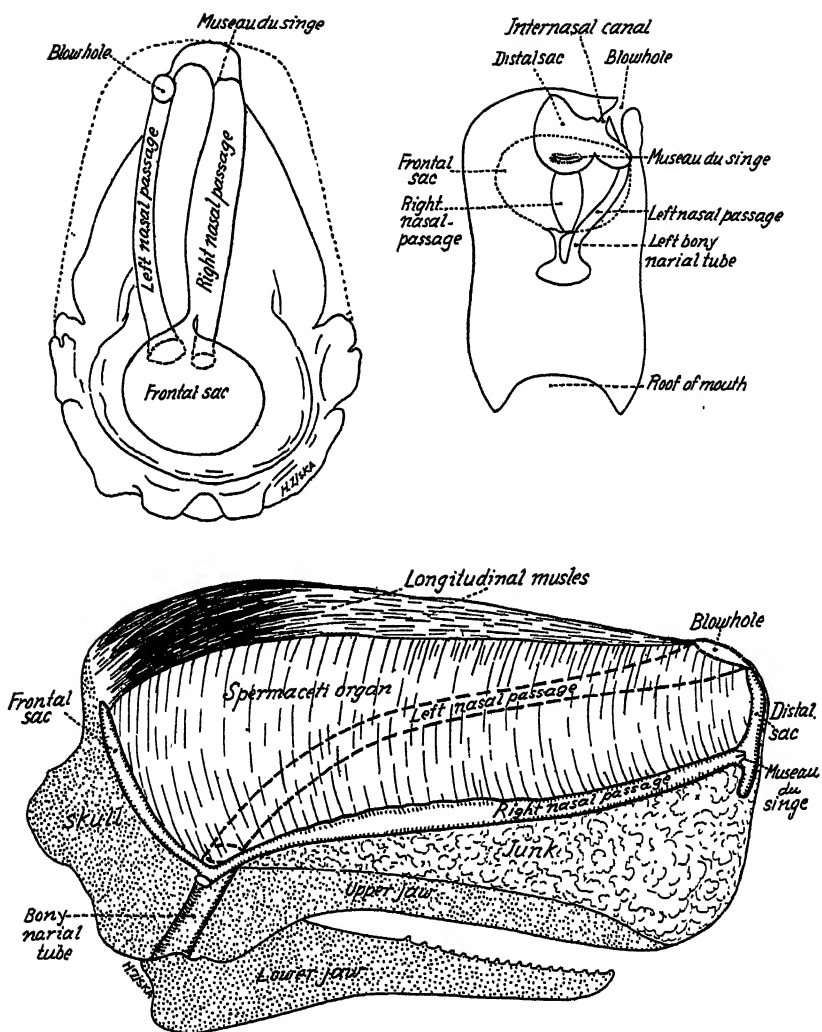


Fig. 4. Diagrams showing relations of the spermaceti organ to the junk and to the nasal passages in the young *Physeter*.

Top view; oblique view of head from right side; transverse section.

naso-pharynx. Hence we suspect that the primary function of the case is to make diving possible by firmly closing the outer and inner nasal passages. The large plug that fits into the left bony narial tunnel and the small plug that fits into the right narial tunnel are represented in the sperm whales by similar structures attached to the hinder end of the spermaceti organ. The latter (Figs. 5, 6) is a more or less unevenly ovoid sac with a tough wall of fibro-muscular tissue fastened below to a median raphe and resting on the "junk" or adipose cushion. The latter

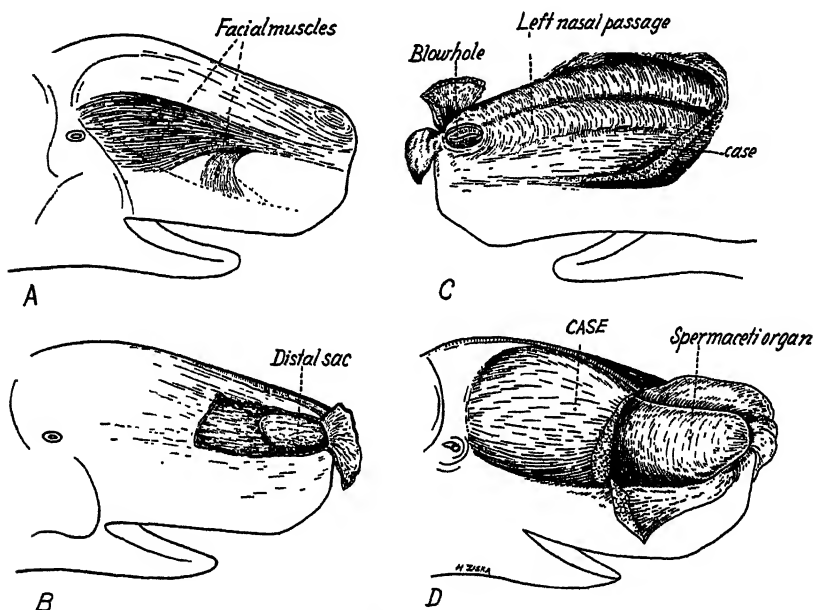


Fig. 5. Dissections of the nasal region of young sperm whale.

- A.—After removal of blubber, showing superficial facial muscles.
 B.—Distal end, right side, showing distal sac overlying spermaceti organ.
 C.—Left side, case partly removed, showing blowhole and left nasal passage beneath transverse muscles of spermaceti organ.
 D.—Right side, case partly reflected, showing spermaceti organ.

appears to be derived from the ventral portion of the muscular sheath that envelops the spermaceti organ. In *Kogia*, according to Kernan and Schulte's dissections (Fig. 8C), the junk appears to be represented by the median longitudinal muscle bundles, lying above the median rostral cartilage, which are connected posteriorly with the front walls of the air passages. In *Physeter* (Fig. 4) the junk consists of alternating vertical stripes of fibrous and fatty tissue. The junk in *Physeter* thus ties

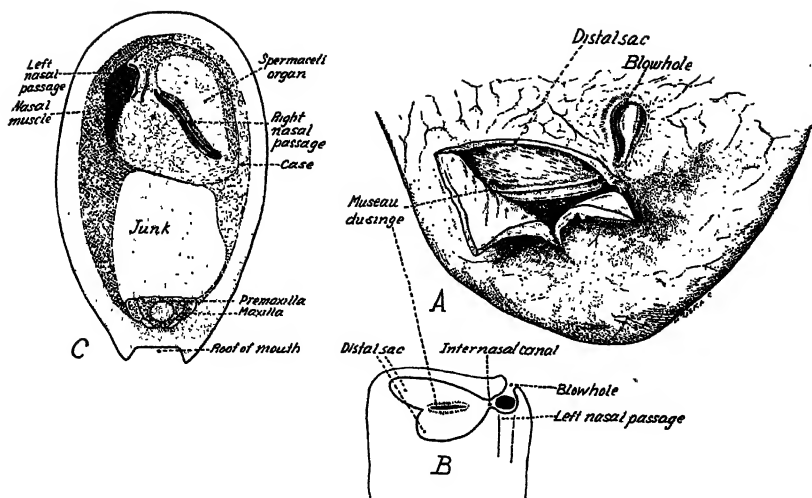


Fig. 6. Relations of the distal sac and associated parts in *Physter*.

A.—Oblique dorsolateral view of front end of head, showing MUSEAU DU SINGE (right nostril) opening into distal sac.

B.—Diagram, front view, showing location of distal sac in young sperm whale, with MUSEAU DU SINGE opening into it from right nasal passage; blowhole opening into vestibule; internasal canal.

C.—Cross-section of front of head behind blowhole, seen from the rear.

A, C, after Pouchet and Beaugregard.

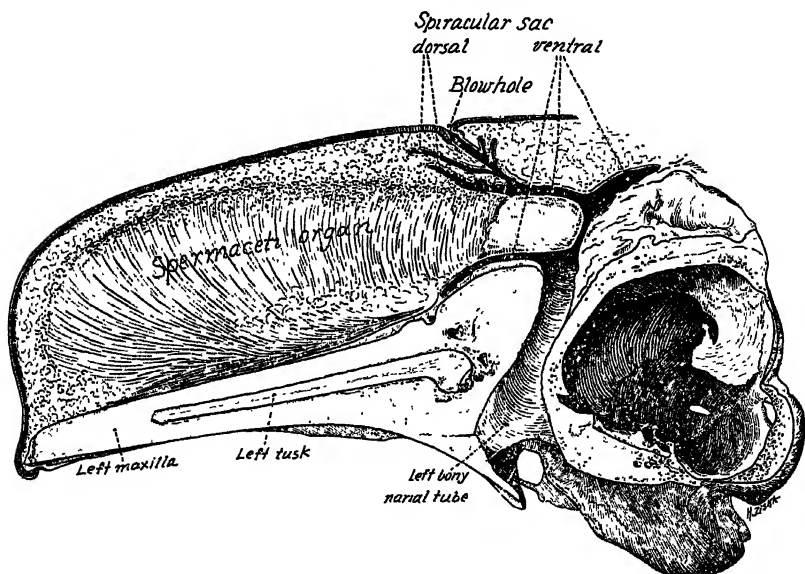


Fig. 7. Longitudinal section of the rostrum and skull of female narwhal (*Monodon*).

the movable spermaceti organ at its median base to the powerful bony rostrum.

The interior of the spermaceti organ, as is well known, contains an immense quantity (reaching as much as fifteen barrels) of the spermaceti oil. This cavity doubtless represents the concrescence of the numerous small spaces filled with oil that are to be found in the interior of the snout of ordinary toothed whales. Whatever other physiological functions the spermaceti organ may have, we are convinced that, with

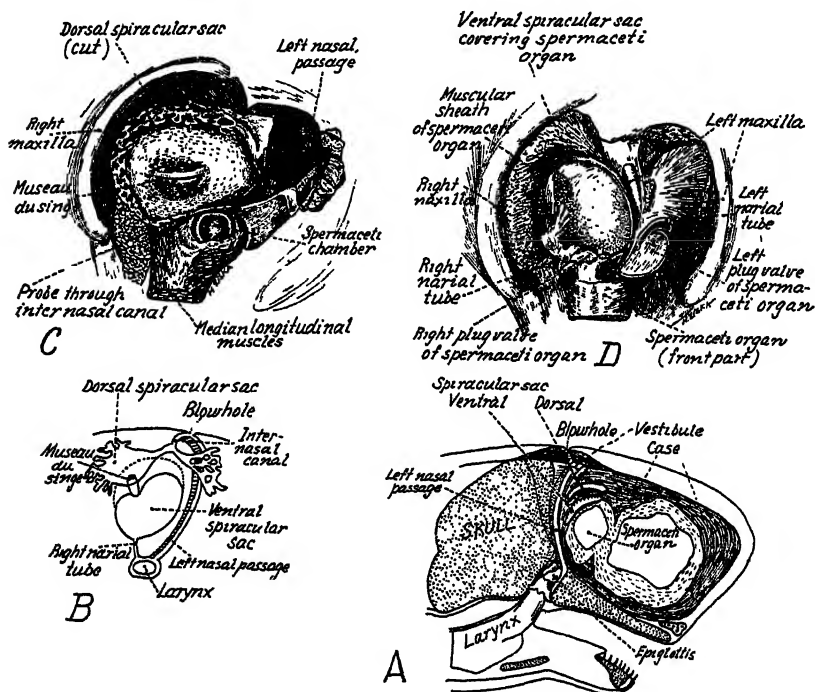


Fig. 8. A.—Diagram, longitudinal section of head of *Kogia*. After Benham.
 B.—Diagram, front view, relations of spiracular sacs, etc., projected on transverse plane. After Benham.
 C.—Foetal *Kogia*. Dissection of head, seen from above, after removal of blowhole and top of dorsal spiracular sac. After Kernan and Schulte, but with modified terminology.
 D.—Foetal *Kogia*. Deep dissection, after removal of dorsal spiracular sac and upper part of ventral spiracular sac.
 The floor of the ventral spiracular sac covers the rear part of the spermaceti organ. After Kernan and Schulte.

regard to the narial passages, one of its functions is to transmit the pressure from the muscles to the plugs or valves that project from its hinder end into the nasal passages. Although the more precise movements of these muscles and valves are, of course, difficult to discover, a contraction of the longitudinal muscles would protract the narial plugs of the spermaceti organ, thus opening the passage between the blowhole and the bony narial tubes, while contraction of the superficial musculature extending from the occiput forward would compress the spermaceti organ and close the entire passage.

THE SPIRACULAR SACS AND NASAL PASSAGES OF *PHYSETER*

We come next to the strange complex conformation of the "spiracular sacs" and nasal passages in *Physeter* which Pouchet and Beauregard mistook for dilatations of the spermaceti chamber (Kernan and Schulte, p. 245). *Physeter* is the only odontocete in which the blowhole (Fig. 9) is near the front end of the head; it also has perhaps one of the two most specialized of all known mammalian skulls (that of *Kogia* being the other) and its nasal passages reach the peak of regional differentiation and complexity. We may therefore conclude that the distal position of the blowhole in *Physeter* is a secondary or relatively recent specialization and that it is correlated with the enormous size of the spermaceti organ. Moreover, the distal position of the expansible spiracular sac, which will presently be described, may also have an appreciable effect in raising the front end of the long head when the animal wishes to rise from the depths.

The nasal passages of our young *Physeter*, which lie above the bony narial passages of the naso-pharynx, may now be briefly described. The blowhole lies on the surface of a boss that is located on the left side near the summit of the front end of the head (Fig. 9). The nasal slit (Fig. 5C), slightly sigmoid in shape and about eight inches long in our specimen, is guarded by subequal massive lips which are provided with sphincter and dilator muscles. The blowhole leads down into a small vestibule or dilatation of the left nasal passage (Fig. 6B). This vestibule is about five or six inches in diameter and seems to have been distensible. It is lined with smooth black epithelium and leads backward into the large pipe-like left nasal passage (Fig. 5C). This passage courses downward and backward just beneath the shell of nasal muscles surrounding the case (Fig. 6C) and just outside of, or lateral to, the spermaceti organ, past the plug-like valve that is attached to the spermaceti organ and down into the enlarged left bony narial tube. Thus the passage from the

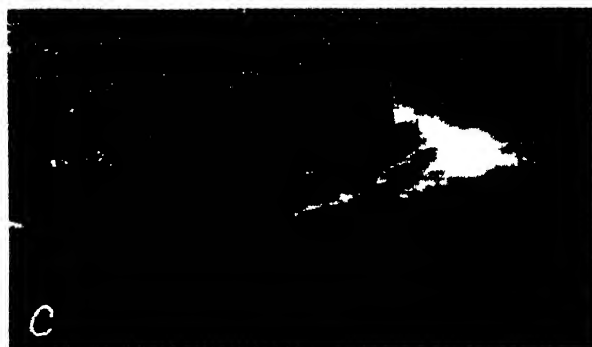
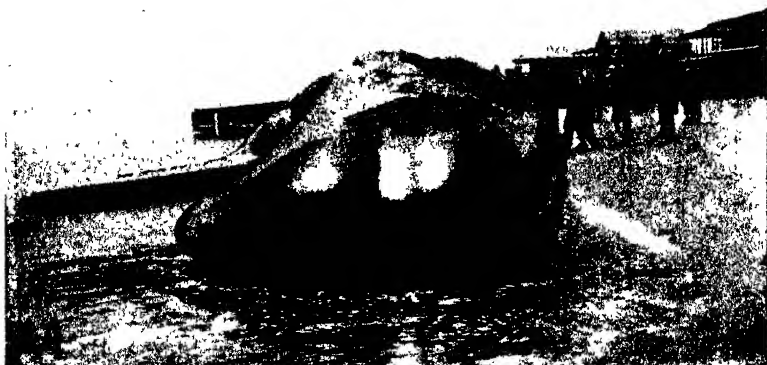


Fig. 9. A.—Front of head of adult sperm whale. The swellings indicate the position of the distal sac, at the right, and of the junk, at the left.
B.—Sperm whale, head rising, exhalation at its maximum.
C.—Sperm whale, head sinking, spiracle dilated for inhalation.

Courtesy of Dr. Robert Cushman Murphy.

windpipe to the left nostril (the blowhole) is very direct and is blocked only by the crescentic valve of the spermaceti organ and by the lips of the blowhole.

From the front end of the vestibule a small canal, hereafter called the internasal canal (Fig. 6B), leads forward to a great distal sac, the homologue of the "dorsal spiracular sac" of *Kogia* (Fig. 8) as described by Kernan and Schulte. This sac in *Physeter* (Fig. 5B) is found wrapped around the bow-like front end of the enormous spermaceti organ and immediately beneath the muscular sheath of the latter. It is therefore the first cavity encountered on piercing the thick skin around the upper front end of the head. Seen from in front (Fig. 6B), this distal sac is irregularly triangular. Its hinder wall is perforated by a wide, nearly transverse, mouth-like slit (Fig. 6A, B), called *musseau de singe* by Pouchet and Beauregard. This valve, which may represent the right nostril, is shaped like upper and lower lips and opens forward. Behind the valve lies the right nasal passage (Fig. 4A, 6C), which, unlike the left passage, is widely expanded and lies deep, mostly beneath the spermaceti organ and above the adipose cushion or junk. At the hinder end of the right nasal passage (Fig. 4A, B) and immediately in front of the small right bony narial tube, the right nasal passage gives off an immense diverticulum, which we may call the FRONTAL SAC, since it lies on the surface of the dorsal basin of the skull. This frontal sac is wrapped around the hinder end of the melon-like spermaceti organ, of which it forms, indeed, the posterior or caudal wall. It is also the covering of both the right and left spermaceti plugs that occlude the bony narial tubes. This frontal sac is evidently homologous with the "ventral spiracular sac" of *Kogia* (Fig. 8) which likewise surrounds the hinder end of the spermaceti organ. In common with that organ the sac would be compressed by the contraction of the great frontal dome of nasal muscles which is fastened around the raised bony border of the occiput and along the sides of the maxilla (Fig. 8D).

We are of course unaware of the precise movements and functions of the parts of the nasal complex, but it seems not improbable that the spermaceti organ and the nasal tubes and pouches may in some way regulate the effects of variations in pressure according to depth. For example, contraction of the longitudinal muscles of the spermaceti organ by pulling open the "spermaceti plugs" might allow air to come up from the lungs into the nasal sacs and passages, and thus relieve some of the pressure on the lungs. Possibly the pressures in the deeper chambers are greater than in the more superficial ones into which they open.

Thus the left nasal passage may be most used in quick exhalation and inhalation, while the right passage with its small openings and expanded sacs may be used in gradual adjustments of pressures.

COMPARISON OF THE PARTS OF THE NASAL APPARATUS IN
PHYSETER, *KOGIA*, AND THE LOWER ODONTOCETES

We seem now to be in a position to try to homologize the various parts of the nasal complex in typical odontocetes, *Physeter* and *Kogia*, as in the appended table.

PHYLOGENETIC RELATIONS OF *PHYSETER* AND *KOGIA*

From inspection of the table, p. 18, it will be seen that we regard *Kogia* as essentially a dwarfed sperm whale, excessively specialized in its nasal structures but closely related to *Physeter*. We base this conclusion partly on the above comparisons of the soft parts, partly on the comparative osteology of the skull. The spiracular sacs, nasal passages and spermaceti organ of *Kogia* are only with difficulty compared with those of ordinary odontocetes but are readily interpretable as a specialization beyond the stage illustrated in *Physeter*.

This interpretation is supported by the fact that in its skull, *Kogia* represents the extreme stage (Fig. 3) in a process of brachycephalization. If we express the maximum skull width, across the top of the orbits, as a percentage of the basilar length, from premaxillae to occipital condyles, we obtain the following series:

<i>Prozeuglodon</i>	<i>Squalodon</i>	<i>Diaphorocetus</i>	<i>Physeter</i> (Young)	<i>Kogia</i>
35	31	52	60	91

Doubtless this is not a direct phylogenetic series but it sufficiently well illustrates the extreme widening of the cranium and secondary abbreviation of the rostrum in the end forms, a process that has taken place to a lesser degree in other series of odontocetes, especially in the lines leading to *Orca*, *Monodon* and the Ziphiidae.

Second, the dentition of *Kogia* is highly specialized: (a) the maxillary teeth are reduced to one or two pairs in the adult (Schulte 1917, page 377); (b) these teeth are set in a continuous alveolar groove; (c) the symphysis of the mandible is secondarily abbreviated, a long symphysis with a high number of mandibular teeth being conspicuous in the numerous, less specialized Miocene odontocetes (Kellogg, 1928, pp. 176, 177).

Third, the disparity of the left over the right bony narial tube is even more pronounced in *Kogia* than in *Physeter*.

Fourth, the same extreme disparity and asymmetry in *Kogia* is noticeable in the bony fossae borne on the dorsal surfaces of the backwardly extended premaxillae and maxillae; these severally support the enlarged right ventral spiracular sac and the curving spermaceti organ which is pushed into it. Kernan and Schulte compare this part of the spermaceti organ to a finger crooked toward the right; as a result of the extreme backward displacement of the spermaceti organ, the ethmoid septum is sharply deflected toward the left. The left maxilla bears a "sagittal" crest marking the limits of the spermaceti organ, while all trace of the left nasal bones has disappeared. In *Physeter*, on the contrary, the huge spermaceti organ is extended far forward on the less reduced rostrum. The frontal sac also has become so huge that it has pushed the enclosing sheath of nasal muscles up on to the narrow rim of the occipital crest (Fig. 3).

It is possible that these differences between *Kogia* and *Physeter* may measure the amount of divergence from a relatively late stem form, such as the Middle Miocene *Aulophyseter morricei* (Fig. 3) as figured by Kellogg (1928, Figure 14), in which evidently neither the spermaceti organ nor the frontal sac had attained the huge development seen in *Physeter*. At any rate we suspect that the anatomical and osteological differences between *Kogia* and *Physeter* are of less than family value. This seems to be in harmony with the following passages from Schulte (1917, pp. 401, 402):

" . . . It has not seemed desirable to retail the profound resemblances which have served to collocate the two forms since the first observation of the skull of *Kogia*. As compared with one another *Kogia* seems to show more striking modifications of the cranium, in only a few characters does *Physeter* possess equally marked peculiarities. . . .

After further discussion of the divergent differences, Schulte continues:

"The conclusion seems therefore warranted, subject to the limitation that cranial characters are alone considered here, that *Kogia* is the more highly modified form but that both have deviated in different directions from the common ancestral type."

SUMMARY AND CONCLUSIONS

1.—The SPERMACETI ORGAN is a mass of fat-filled areolar tissue which has arisen as a specialization of the deep parts of the nose, *pari passu* with the retreat of the nostrils to the top of the skull and with the formation of a nasal turret, consisting of respiratory sacs surrounded by nasal muscles. The hinder or caudal end of the spermaceti organ lies between the left and right nasal passages, which are occluded by fleshy plugs that project from its hinder end.

2.—In *Physeter* the spermaceti organ extends the whole length of the rostrum in front of the FRONTAL SAC; the latter is a diverticulum from the right nasal passage and closely surrounds the rear end of the spermaceti organ.

3.—In *Physeter* the DISTAL SAC, which is an expansion of the right nostril cavity, leads back through the MUSEAU DE SINGE or right nostril into a long, greatly expanded right nasal passage which lies beneath the huge spermaceti organ. In *Kogia* the right nasal passage is very short and is surrounded by the winding pillar of the spermaceti organ; the distal sac (called the "dorsal spiracular sac") is greatly expanded but with the extreme shortening of the snout now lies above the eyes, as does also the blowhole.

4.—In *Physeter* the spermaceti organ and its surrounding muscular sheath, besides assisting in the closure of the nasal passages after inhalation, may also function in other ways: (a) opening the spiracular sacs, (b) admitting small quantities of air under high pressure from the lungs to the distensible right nasal passage and frontal sac, (c) possibly also in shifting the center of gravity of the snout by suitable movements of the air, oil and blood contained in the several reservoirs.

5.—While in general *Kogia* is more highly specialized both in the soft parts and in the skeletal supports of the nasal complex, both genera seem to be derivable, at least in this region, from some of the Mid-Tertiary physeteroids, especially *Aulophyseter morricei* as figured by Kellogg.

6.—The "telescoping" of the maxillae and premaxillae on to the top of the skull in odontocetes seems to be attributable rather to the backward shifting of the nasal turret than to the direct push of the water upon the forwardly moving rostrum.

BIBLIOGRAPHY

- ABEL, O. 1901. 'Les dauphins longirostres du Boldérien (Miocène supérieur) des environs d'Anvers. Part I.' Mém. Mus. Roy. d'Hist. Nat. de Belgique, Bruxelles, I, pp. 1-95, Pls. 1-x, Text Figs. 1-17.
- 1902a. 'Die Ursache der Asymmetrie des Zahnwalschädels.' Sitzungsber. k. Akad. Wiss., Wien, III, pp. 510-526, Pl. 1.
- 1902b. 'Les dauphins longirostres du Boldérien (Miocène supérieur) des environs d'Anvers. Part II.' Mém. Mus. Roy. d'Hist. Nat. de Belgique, Bruxelles, II, pp. 101-188, Pls. xi-xviii, Text. Figs. 18-20.
- BENEAM, W. BLAXLAND. 1901. 'On the anatomy of *Cogia breviceps*.' Proc. Zool. Soc. London, II, pp. 107-134, Pls. viii-xi, Text Figs. 7, 8.
- DANOIS, ED. 1910. 'Recherches sur l'anatomie de la tête de *Kogia breviceps* Blainv.' Arch. Zool. Expér. Gén., 1910-1911, (5), VI, pp. 149-174, Pls. v-viii, figs. 1-5.

- FRAAS, E. 1904. 'Neue Zeuglodonten aus dem unteren Mitteleocän vom Mokattam bei Kairo.' Geol. u. Palaeont. Abhandl., Jena, X, part 3, pp. 199-220, Pls. x-xii.
- GIDLEY, J. W. 1913. 'A recently mounted *Zeuglodon* skeleton in the United States National Museum.' Proc. U. S. Nat. Mus., XLIV, No. 1975, pp. 649-654, Pls. LXXXI, LXXXII, Text Figs. 1-3.
- HOWELL, A. BRAZIER. 1927. 'Contribution to the anatomy of the Chinese finless porpoise *Neomeris phocaenoides*.' Proc. U. S. Nat. Mus., LXX, Art. 13, pp. 1-43, Pl. I, figs. 1-14.
1930. 'Aquatic mammals: their adaptations to life in the water.' Charles C. Thomas. Illinois and Maryland. 338 pp., 53 Figs.
- JACKSON, J. B. S. 1847. 'Dissection of a spermaceti whale and three other cetaceans.' Boston Journ. Nat. Hist., V, pp. 137-171 [Describes alimentary canal, genito-urinary organs, heart, lungs, trachea and larynx.]
- KELLOGG, REMINGTON. 1928a. 'The history of whales—their adaptation to life in the water.' Quarterly Rev. Biol., III, No. 1, pp. 29-76, 11 Figs.
- 1928b. 'The history of whales—their adaptation to life in the water (concluded).' Quarterly Rev. Biol., III, No. 2, pp. 174-208, 24 Figs.
- KERNAN, JOHN D., JR., AND SCHULTE, H. VON W. 1918. 'Memoranda upon the anatomy of the respiratory tract, foregut, and thoracic viscera of a foetal *Kogia breviceps*.' Bull. Amer. Mus. Nat. Hist., XXXVIII, pp. 231-267, 16 Figs.
- MILLER, G. S., JR. 1923. 'The telescoping of the cetacean skull.' Smithsonian Misc. Coll., LXXXVI, No. 2720, pp. 1-70, Pls. I-VIII.
- POUCHET, G., AND BEAUREGARD, H. 1885. 'Note sur "L'Organe des Spermaceti."' Comptes Rendus Hebdomadaires des Séances et Mémoires de la Soc. de Biol., (8) II, pp. 342-344.
1892. 'Recherches sur le cachalot.' Nouvelles Arch. du Mus. d'Hist. Nat., (3) IV, pp. 1-86, Pls. I-XII.
- SCHULTE, H. VON W. 1917. 'The skull of *Kogia breviceps* Blainv.' Bull. Amer. Mus. Nat. Hist., XXXVII, pp. 361-404, Pls. XXXV-XLIII, 2 Figs.
- SCHULTE, H. VON W., AND SMITH, M. DE FOREST. 1918. 'The external characters, skeletal muscles, and peripheral nerves of *Kogia breviceps* (Blainville).' Bull. Amer. Mus. Nat. Hist., XXXVIII, pp. 7-72, 21 Figs.

PRIMITIVE CETACEANS <i>Protocetus</i> (Fraas)	TYPICAL ODONTOCETES <i>Tursiops</i> , <i>Neomeris</i> (Brazil Howell) <i>Monodon</i> (H. C. Raven)	<i>Physalus</i> (H. C. Raven)	<i>Sperm. whales</i> <i>Kogia</i> (Kernan and Schultze)
Nostrils symmetrical above middle of long rostrum	Nostrils retracted to above orbits, asymmetrical, the left (= blowhole) enlarged	Blowhole removed to near distal end of rostrum	Rostrum greatly shortened, blowhole above orbits
Nostrils enclosing small cavities	Cavity of nostrils expanded, giving rise to 2 or 3 respiratory sacs	Vestibule, immediately below blowhole Internasal canal (connecting right and left nasal passages) Distal sac, containing MUSCLES OF SINGE (=right nostril) (Figs. 4, 5, 6) Left nasal passage (Fig. 6C) Right nasal passage, elongate and greatly expanded, beneath spermaceti organ (Figs. 4, 6) Frontal sac, behind spermaceti organ (Fig. 4)	"Vestibule" (Fig. 8A) "Canal connecting vestibule and dorsal spiracular chamber" (Fig. 8C, probe) "Dorsal spiracular sac" containing "orifice of right passage" at bottom "Left nasal passage" (Fig. 8B) "Right nasal passage," greatly shortened "Ventral spiracular sac" folded around spermaceti organ (Fig. 8)
Nasal muscles enclosing cavities of nostrils and mucous tissue	"Melon" of fat-bearing tissue enclosed in sheath of facial muscles (Fig. 7) Left narial plug, hinder end of melon Right narial plug, hinder end of melon	Spermaceti organ long, containing huge oil chamber Left narial plug attached to spermaceti organ Right narial plug attached to spermaceti organ	Spermaceti organ short and high with voluminous oil chamber (Fig. 8A) "Rostral wall of left air passage" (Fig. 8D) "Caudal pillar of spermaceti organ."

AMERICAN MUSEUM NOVITATES

Number 678

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Dec. 2, 1933

56.81,4 C: 14.71,4

A SKULL OF *CROCODILUS CLAVIS* COPE, IN THE UNITED STATES NATIONAL MUSEUM¹

BY CHARLES C. MOOK

INTRODUCTION

In the collections of the United States National Museum is a fairly well-preserved skull of *Crocodylus clavis* Cope, that exhibits characters of this species not heretofore put on record. My thanks are due to Mr. Charles W. Gilmore, Curator of Vertebrate Paleontology in the U. S. National Museum, for permission to describe this specimen.

GENERAL FORM OF THE SKULL

The skull is of moderate size and is moderately broad in proportion to its length. The length of the snout is about one and a half times its breadth at the base. Its lateral borders converge forward more rapidly than do the lateral borders of the cranial table. The notches which receive the fourth lower teeth are of moderate depth. They separate off a tip of the snout which is only slightly broader than it is long.

The cranial table is flat. This character may be accentuated by crushing, but is not entirely due to this cause. The lateral borders of the cranial table are nearly parallel. The antero-external corners of the table are broadly rounded. The postero-external corners are produced considerably backward. The mid-region also extends backward somewhat. This makes the posterior border wavy in form.

The plate between the supratemporal fenestrae is of moderate breadth, and is about equal in breadth to the space between each fenestra and the posterior border and to the bar between each fenestra and the external border. It is narrower than the bar between each fenestra and the corresponding orbit. It is much narrower than the broad, flat, inter-orbital plate.

THE CAVITIES OF THE SKULL

EXTERNAL NARIAL APERTURE.—The borders of the external narial aperture are not completely preserved, but they are sufficiently preserved to indicate that the aperture was bluntly pear-shaped. Its breadth is

¹Contributions to the Osteology, Affinities, and Distribution of the *Crocodylia*, No. 27.

about two-thirds of its length. *The entire aperture is anterior in position to the lateral notches.* This is a distinctive character, as in many crocodilians the aperture extends backward beyond the level of the notches.

ORBITS.—The borders of the orbits are not complete, but it is apparent that they were of moderate size, and that their length was considerably greater than their breadth. The interorbital plate separating them is broad and flat.

SUPRATEMPORAL FENESTRAE.—The supratemporal fenestrae are of moderate size. The antero-posterior diameter of each is about equal to the transverse diameter. The fenestrae are not circular, however, but are elongated obliquely, the axes of greatest length making angles slightly greater than 45° with the antero-posterior direction; they converge posteriorly.

PREMAXILLARY FORAMEN.—The region of the palate surrounding the premaxillary foramen is not preserved, so that the boundaries of that foramen cannot be determined. It is clear, however, that the foramen could not have been very large.

PALATINE FENESTRAE.—The palatine fenestrae are very long and narrow. The left one, whose boundaries are complete, has a length two and a half times as great as its breadth. The length of this fenestra is twenty-nine per cent. of the total length of the skull from the tip of the snout to the occipital condyle.

These fenestrae extend from the level of the tenth maxillary teeth to a level slightly back of the posterior end of the tooth row. The breadth of the left fenestra is slightly greater than that of the right, due to crushing. The palatine plate between the two fenestrae is about as broad as the average breadth of the fenestrae. The boundaries are irregular.

INTERNAL NARIAL APERTURE.—The pterygoids are incompletely preserved, but the anterior border of the internal narial aperture is clearly visible. The position of this border is slightly anterior to a point halfway between the intersection of the palatine-ptyergoid suture at the mid-line and the descending process of the basioccipital. This is slightly anterior to the normal position in the living crocodilians, and considerably posterior to the position in the normal Mesozoic forms. It is in an expected position for an Upper Eocene crocodile.

THE BONES OF THE SKULL

While the preservation of the skull is not complete enough to permit detailed description of many of the skull bones, some of the characters of many of the bones are sufficiently clear to warrant description.

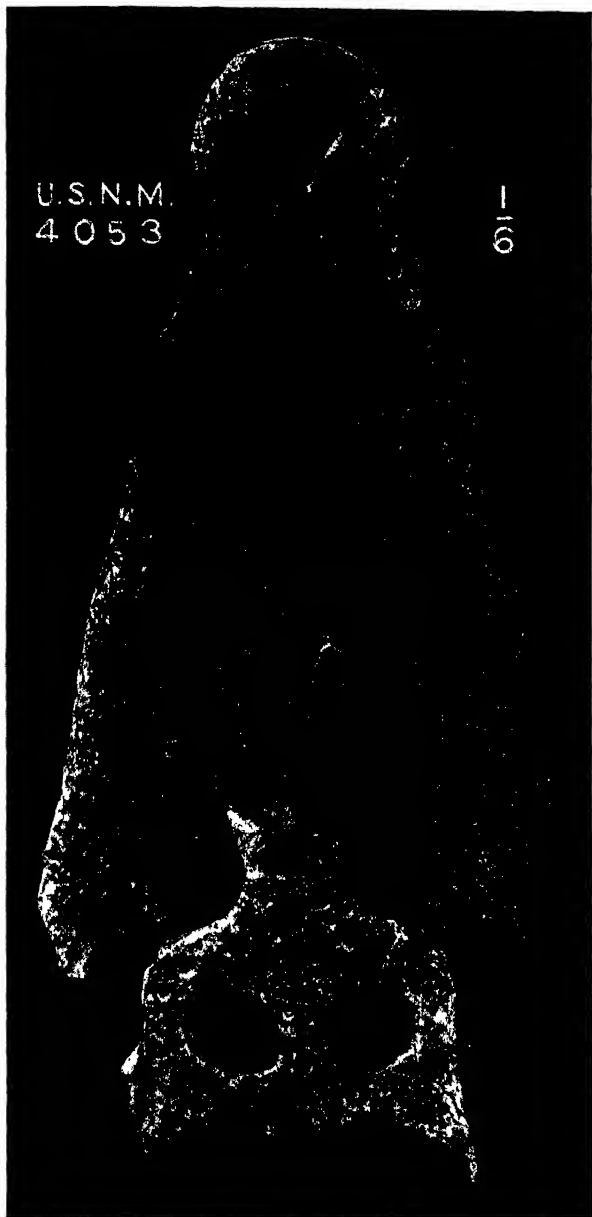


Fig. 1. *Crocodilus clavis* Cope. Skull (U. S. Nat. Mus. No. 4053). One-sixth natural size. Superior view.

PREMAXILLARIES.—The premaxillaries are very short anterior to the external narial aperture, and are broad between the aperture and the lateral borders of the snout. The posterior processes are not preserved, but by projecting the premaxillo-maxillary sutures and the maxillo-nasal sutures backward, it appears probable that these processes extended back to the level of the fifth maxillary teeth.

On the palate the length of the premaxillaries is about equal to the maximum breadth of the two of them. The premaxillo-maxillary suture extends almost directly inward and backward from the lateral notch to the mid-line, and back to the opposite notch. The intersection of this suture with the mid-line is slightly anterior to the level of the posterior borders of the first premaxillary teeth.

Each premaxillary evidently had five teeth. The alveoli of the five on the left side are preserved, and three on the right side. In relative order of size, from the first to the fifth, as determined from the alveoli, these teeth are: second, smallest; first, second in size; third and fifth equal and slightly larger; and fourth, the largest. The first alveolus is close to the mid-line, and is widely separated from the second. The second is very close to the third. The third is moderately close to the fourth, and the fourth is moderately close to the fifth.

MAXILLARIES.—The maxillaries widen rapidly posterior to the premaxillo-maxillary notch. Their contacts with the premaxillaries and the nasals are obscure or missing on the skull top, but the maxillo-nasal sutures may be reasonably interpreted as extending from the level of the fifth to the level of the eleventh maxillary teeth. The postero-lateral processes extend back to the level of the centers of the orbits.

The premaxillo-maxillary suture on the palate has been described above. The maxillaries are incomplete along the mid-line, and the level of the anterior point of their intersection with the palatines cannot be determined.

All of the alveoli of the right side, and many of those of the left side, are preserved. The first five are close together, and increase in size regularly from the first to the fifth; the fifth is much larger than the fourth. The sixth is very close to the fifth and is slightly larger than the fourth. The seventh is moderately distant from the sixth. The seventh, eighth, and ninth are close together, and are about equal in size to the third. The tenth is equal in size to the seventh, eighth, or ninth, but is separated somewhat from the ninth. The eleventh is somewhat separated from the tenth. The eleventh to the sixteenth alveoli, inclusive, are all close together, and decrease regularly in size from the eleventh backward. The eleventh alveolus is second in size to the fifth.



Fig. 2. *Crocodilus clavis* Cope. Skull (U. S. Nat. Mus. No. 4053). One-sixth natural size. Inferior view.

FRONTAL.—The frontal is unusually broad between the orbits. It forms no part of the boundaries of the supratemporal fenestrae. The supraoccipital occupies a small area of the surface of the cranial table.

OTHER BONES.—Other bones are not sufficiently distinctive, as preserved, to warrant detailed description.

LOWER JAWS

The symphyseal region, and a portion of the right ramus at the posterior end of the tooth row, are fairly well preserved. The symphysis is relatively long and narrow. Its breadth is about four-fifths of its length. The anterior portion of the left ramus is particularly well preserved. In it 6 alveoli are preserved in the symphyseal region. The first alveolus contains the broken base of a tooth. All of the alveoli are elongate in outline. This does not indicate that the cross-sections of the teeth were oval, but that the teeth were inclined in position, extending forward as well as upward from bases to crowns. The fourth alveolus is much larger than the other five, which are subequal in size. The first and second, and the second and third teeth are spaced moderately far apart, but the third and fourth, the fourth and fifth, and the fifth and sixth, are all close together. Farther back this ramus contains five more alveoli. The outlines of some of these are not clear.

This ramus is not preserved posterior to the eleventh teeth. The right ramus has the region of the first alveolus missing, but the second to the ninth are present. Posterior to the ninth is an irregular portion of the dentary which might have lodged three more alveoli. Posterior to this the ramus is not preserved except for a small isolated fragment. This fragment contains



Fig. 3. *Crocodylus clavis* Cope. Portions of mandible (U. S. Nat. Mus. 4053). One-sixth natural size. Superior view.

the last two alveoli, with the next to the last tooth almost complete. The extent of the missing portion between this fragment and the anterior portion of the jaw is uncertain: By placing both anterior portion and fragment in contact with the skull the position of the fragment with the anterior portion of the ramus can be determined with a fair degree of accuracy. By this method it appears likely that three or four teeth were lodged in the missing portion. This would mean seventeen or eighteen teeth for the ramus. This is too many for the genus *Crocodylus*, as we understand the genus to-day, but corresponds with the number in several Eocene species usually referred to *Crocodylus*. Pending a revision of the Bridger species of *Crocodylus*, the species *clavis* may be retained in the genus *Crocodylus*. Such a revision may necessitate its reference to a different genus. The splenial bones evidently did not reach the symphysis.

CONCLUSIONS

The material described enables us to determine certain characters of this species that have not been listed before, especially the characters of the symphysis of the lower jaw.

AMERICAN MUSEUM NOVITATES

Number 679

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Dec. 4, 1933

56.81, 9 (117:51.7)

TWO NEW DINOSAURIAN REPTILES FROM MONGOLIA WITH NOTES ON SOME FRAGMENTARY SPECIMENS¹

By CHARLES W. GILMORE²

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INTRODUCTION

The present paper gives the results of a study of the residue of the dinosaur collections made in Mongolia by various Asiatic expeditions of The American Museum of Natural History. All of the material is fragmentary, but diagnostic parts of two of the specimens are sufficiently preserved to be worthy of detailed description. One records the presence of a new genus and species of the Nodosauridae, the other a new genus and species of the Sauropoda. The remaining specimens, none of which permit of more than family identification, are of interest either in recording new localities for dinosaur remains or in constituting the sole evidence of their presence in certain formations.

I wish to express to Dr. Walter Granger my appreciation for the opportunity given me to study this interesting material, and also for his assistance in all matters pertaining to the work; to Mr. Sydney Prentice, I am grateful for his skill and patience in delineating these difficult subjects.

In the table to follow is set forth the geological distribution of the Dinosauria in Mongolia, compiled from all available sources. A striking approximation to their distribution in North America is shown.

¹Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 118.

²Curator of Vertebrate Paleontology, United States National Museum.

CHRONOLOGICAL DISTRIBUTION OF THE DINOSAURIA IN MONGOLIA

Geologic Age	Formation	Approximate thickness in feet	Faunal List
Upper Cretaceous	Djadochta	500'	<i>Protoceratops andrewsi</i> Granger and Gregory <i>Velociraptor mongoliensis</i> Osborn <i>Oviraptor philoceratops</i> Osborn <i>Sauromithoides mongoliensis</i> Osborn Theropod (Deinodont?) <i>Pinacosaurus grangeri</i> Gilmore
	Iren Dabasu	80'	<i>Ornithomimus asiaticus</i> Gilmore <i>Alectrosaurus olseni</i> Gilmore <i>Mandschurosaurus mongoliensis</i> Gilmore <i>Bactrosaurus johnsoni</i> Gilmore Nodosauridae, gen. and sp. indet.
	Nantienmen	2500' +	Theropod
	Dohoin Usu	300' ±	Hadrosauridae, gen. and sp. indet. Theropod
Lower Cretaceous	Dubshih	1000' ±	
	Ochungchelo	2000' ±	Sauropod fragment
	Tairum Nor	100'	Ornithomimid? gen. and sp. indet. Dinosaur indet.
	Baiying Bologai	150'	Ceratopsidae? gen. and sp. indet. Hadrosauridae, gen. and sp. indet.
	Jasu Jergulung	100' ±	
	Go Yoto	250' ±	
	Shirigu	?	Dinosaur fragments indet.
	Oshih	2000' ±	<i>Asiatosaurus mongoliensis</i> Osborn <i>Prodeinodon mongoliense</i> Osborn <i>Psittacosaurus mongoliensis</i> Osborn
	On Gong	500' +	<i>Mongolosaurus haplodon</i> Gilmore
	Ondai Sair	500' +	<i>Protiguanodon mongoliense</i> Osborn Sauropod (rib)

DESCRIPTION OF GENERA AND SPECIES

Order **ORTHOPODA**Family **NODOSAURIDAE**

The family Nodosauridae is represented in Mongolia by two specimens, an incomplete ilium from the Iren Dabasu formation, and a poorly preserved skull from the Djadochta formation about to be described as the type of a new genus and species. Attention has been called in a previous paper¹ to a third occurrence of this family in eastern Asia, a specimen from Shantung, China.

The specimen to be described is so badly crushed and broken that much of its detailed structure is obscured, but in view of its unique occurrence, it seems worthy of description, although I am fully aware of the meagerness of its characterization.

Pinacosaurus grangeri, new genus, new species

TYPE:—No. 6523, A. M. N. H., consists of a badly crushed skull and jaws and a few scattered dermal bones. Collected by Walter Granger, 1923.

LOCALITY:—Shabarakh Usu, Outer Mongolia.

HORIZON:—Djadochta formation, Upper Cretaceous.

GENERIC AND SPECIFIC CHARACTERS:—Skull covered with numerous small osseous scutes; large quadrate + quadratojugal dermal plates; skull relatively slender, longer than wide; beak regularly rounded and apparently devoid of osseous scutes; external nares small, opening laterally; orbits placed well posterior, ovate; palate divided longitudinally by a vertical median bony plate. Teeth extremely small; dentate.

The skull which forms the type of *Pinacosaurus grangeri* was found embedded in a reddish sand and after preparation displays the shattered appearance illustrated in Figures 1 and 2. Although badly crushed and checked in all directions, practically all parts of the skull and lower jaws are present. Viewed from above, the skull has the usual sub-triangular shape of the nodosaurian crania. It is evident that, as in other members of this family, the entire top of the skull is covered with ossified dermal scutes which completely obscure the underlying cranial elements. In an unbroken specimen these ossifications may have been arranged in some definite pattern, but the precise character of this arrangement cannot now be determined. An area on the upper posterior median surface is smooth, but the grain of the bone radiates from a common center much as in *Dyoplosaurus*.² Approaching the lateral margins, especially in the direction of the nose, the scutal surfaces be-

¹Gilmore, Charles W. 1933. Bull. Amer. Mus. Nat. Hist., LXVII, Art. 11, p. 75.

²Gilmore, Charles W. 1930. Proc. U. S. Nat. Mus., LXXVII, Pl. ix.

come progressively roughened, but no special pattern can be detected. Some of the scutes overlying the nasal portion have their centers somewhat raised, and it is quite probable these were set off by circumscribing grooves, as is faintly indicated in one or two instances. Above each orbit

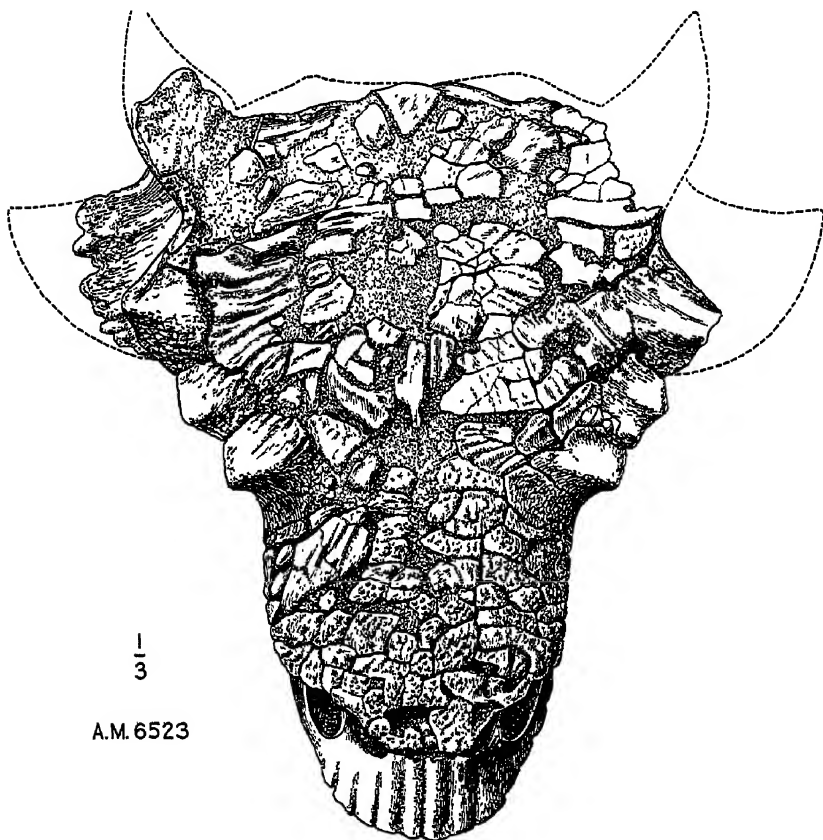


Fig. 1. Skull of *Pinacosaurus grangeri*. Type. No. 6523, A. M. N. H. Top view reconstructed from the badly disorganized original specimen. One-third natural size.

are two moderately large, ridged plates having a sharp edge, and these form ornamental borders that overhang the orbits. A third scute with a lower dorsal keel precedes the two mentioned above. This keel turns strongly inward toward the median line. Each posterior external angle

of the skull seems to have been ornamented by a large spine-like scute as in *Dyoplosaurus* and *Ankylosaurus*, but its precise form cannot be determined from this specimen. The left element is entirely missing and the right has been slightly displaced and so badly crushed and broken that its detailed characteristics are destroyed.

It is quite evident that much, if not all, of the sides of the skull was also covered by dermal bones, but their extent and arrangement cannot be determined. On the posterior inferior angles is a large plate that develops a flattened triangular process which extends strongly downward and outward as in *Dyoplosaurus* and *Euoplocephalus* and completely covers the quadrate and its articulation with the lower jaw. Its form is shown in figure 1. This scute is relatively thin as compared with the more robust element of the *Dyoplosaurus* skull.

The orbits are placed much as in *Dyoplosaurus* and *Euoplocephalus* and are suboval in outline.

The premaxillary region presents a most unusual condition in dinosaurian anatomy from the fact that the usual position of the external nares is occupied by two subovate, longitudinal openings of about equal size, placed one above the other and separated by a horizontal bar (see fig. 1). This condition, when allowance is made for post-mortem distortion, is the same in both premaxillaries. If both openings pertain to the nares, a condition is represented not before known in the Dinosauria. It is quite certain that the two inner openings represent the true narial orifices while the two outer may be homologous to small openings lateral to the nares and leading back into the buccal area in a skull (No. 11868, U. S. N. M.) of *Palaeoscincus*. Direct comparison of the two specimens, however, does not confirm this suggestion. The crushed and broken condition of the type skull makes it quite impossible to trace out the course of these openings, hence a determination of their function must await the discovery of a more perfect specimen. In any event the external nares open laterally. The upper margin of the inner opening was apparently bordered by dermal bone, but all of the premaxillary surfaces in front of these openings appear to have been free of dermal covering, as shown in figure 1.

PALATE:—The palatal side of the skull, although badly crushed and broken (see fig. 2), nevertheless shows much of its structure. Unfortunately, most of the sutures are obliterated, making it impossible to determine the full extent of many of the elements. In its main features, this specimen is in accord with the well preserved palate of *Palaeoscincus rugosidens*,¹ that is, the mouth is divided longitudinally by a vertical

¹Gilmore, Charles W. 1930. Proc. U. S. Nat. Mus., LXXVII, Art. 16, fig. 2.

plate of bone extending from the median junction of the premaxillary bones to the pterygoids; there is a great fore and aft shortening of the pterygoids, and a wide overhang of the buccal area above the maxillary

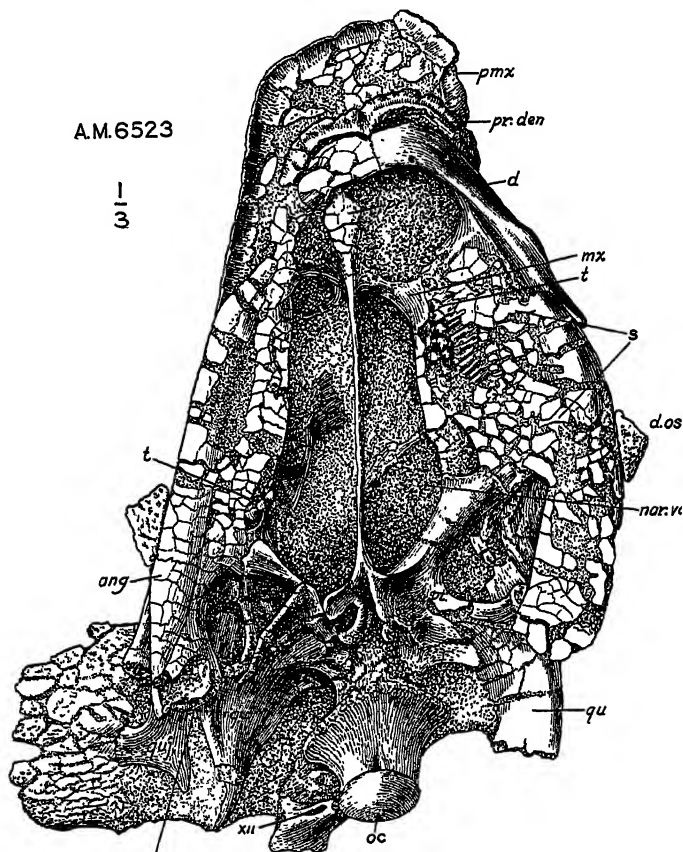


Fig. 2. Skull of *Pinacosaurus grangeri*. Type. No. 6523, A. M. N. H. Ventral view of the skull as it lay in the matrix, shattered and badly crushed. One-third natural size.

Ang., angular; *ar.*, articular; *d.*, dentary; *d. os.*, dermal ossicle on the lower jaw; *exoc.*, exoccipital; *mx.*, maxillary; *nar. vac.*, posterior narial vacuity; *oc.*, occipital condyle; *pmx.*, premaxillary; *pr. den.*, pre-dentary; *pr. v.*, prevomer; *pt.*, pterygoid; *qu.*, quadrato-jugal; *s.*, splenial; *t.*, teeth in maxillary; *XII*, foramen for exit of the twelfth or hypoglossal nerve.

bones. The edentulous premaxillaries form a rounded but comparatively narrow muzzle. Their outer borders curve strongly downward, presenting a sharp cutting edge that in life was probably covered with chitinous

skin, thus forming a very efficient cutting beak. The maxillary bones are almost completely hidden by the lower jaws which are crushed down upon them. The occipital condyle is visible on the lower side (see fig. 2). It is somewhat flattened but relatively small, having a greatest transverse diameter of 33 mm. The basiptyergoid region is so damaged that none of its details can be determined. The pterygoids, as in all of the armored dinosaurs, are extremely short antero-posteriorly. Each pterygoid may be described as consisting of three parts: a thin, wing-like process that extends backward and outward to articulate with the inner side of the quadrate; a heavier, but nearly vertical process that extends forward and outward to articulate with the ectopterygoids, if those elements are present; and a median portion that apparently forms the posterior boundary of the internal nares. The bone of this mid-portion of the pterygoid is too poorly preserved to be worthy of description. It is quite evident, as shown in figure 2, that the internal nares occupy the same posterior position in the palate as in *Palaeoscincus* and *Edmontonia*.

The measurements given below are only approximate, as the broken condition of the skull renders it impossible to obtain precise dimensions.

MEASUREMENTS OF SKULL

Greatest length over all, about.....	305 mm.
Greatest breadth, across tips of jugal processes, about.....	340
Greatest breadth, across posterior end.....	245
Greatest breadth, across center of orbits.....	235
Greatest breadth, across external nares.....	105
Distance between anterior border of orbit and anterior extremity of pre-maxillary at center.....	225
Greatest antero-posterior extent of orbit.....	60
Greatest transverse diameter of occipital condyle.....	33

LOWER JAW:—The rami are preserved in nearly their proper relationship to the skull, as shown in figure 2, but both are so badly crushed and broken that most of their detailed structure is obscured. It is quite evident that they closely resemble the jaws of other armored dinosaurs of the family *Nodosauridae* in general shape and proportions. The post-coronoidal part of the jaw is short, the dentary forming the anterior two-thirds. In front, the ramus is much reduced in height, and it turns strongly inward to meet its fellow on the median line. There is a well developed splenial covering Meckel's groove, whose anterior termination appears to be considerably short of the symphysis. The outer surface of the anterior half of the ramus is devoid of dermal scutes, but the posterior half is much obscured by a triangular, obtusely edged plate

that projects downward and outward below the level of the lower border (see *d.os.*, fig. 2), forming a prominent protuberance at about its posterior third. The lower jaw has a greatest length of about 245 mm. in a straight line.

The predentary is present, but its anterior surface only is visible. It is relatively narrow dorso-ventrally, broadly rounded transversely. At the center on the ventral side there is a slight projection that was interposed between the cojoined rami. The upper anterior border is roughened by a row of node-like eminences.

TEETH:—There are a considerable number of teeth present in both upper and lower jaws, but only a few are available for study, all of these being in the left maxillary; with Doctor Granger's permission, three of

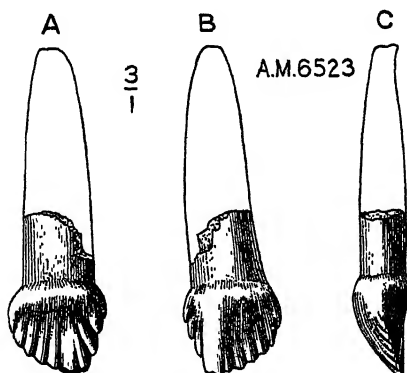


Fig. 3. Left maxillary tooth of *Pinacosaurus grangeri*. No. 6523, A. M. N. H. A, outer view; B, inner view; C, anterior view. All three times natural size.

these were removed in order to observe their details, and one is here illustrated in figure 3. The teeth, so far as they can be observed, are alike in form and size, being smaller than those of *Dyoplosaurus*,¹ which up to this time were the smallest nodosaurian teeth known. The functional teeth consist of a laterally compressed crown with a long cylindrical root. The crown of one well preserved tooth measures 4 mm. antero-posteriorly and 2.3 mm. transversely through the thickest part, and about 4 mm. in height. The outer side of the crown is more rugosely striated and flatter than the inner which is decidedly swollen at the base. The trenchant edge is denticulate, there being eleven denticles on each tooth, three posterior and seven anterior to the apical one which is decidedly

¹Gilmore, Charles W. 1930, Proc. U. S. Nat. Mus., LXXVII, Art. 16, p. 35., fig. 18.

posterior to the center of the crown. On the outer side of the surface the crown is divided into eight principal columns by vertical fluting (see fig. 3A); on the inner side these grooves are much shorter and subside before reaching the swollen base. The large denticles are transversely flattened, the others presenting more or less rounded points. These teeth do not develop a cingulum as in the teeth of *Palaeoscincus* and *Dyoplosaurus*, but the base of the crown is evenly rounded to meet the fang, which is long, smooth-surfaced and subcylindrical in form.

Compared with the teeth of other Nodosauridae, these are nearest in size to those of *Dyoplosaurus acutosquameus* Parks, with which they have been directly compared. In form and great number of denticles they show a closer approach to those of *Edmontonia longiceps* Sternberg¹ but their much smaller size at once distinguishes them.

DERMAL ARMOR:—That the body of this animal was covered by dermal armor is strongly indicated by a few dermal plates remaining in the matrix posterior to the skull. These elements are so poorly preserved as to give little idea of their form, but they leave the impression of being much less massive than the neck plates of *Palaeoscincus*.

RELATIONSHIPS:—On the basis of the skull structure, the genus *Pinacosaurus* is a true member of the family Nodosauridae and it falls readily into the subfamily Ankylosaurinae as defined by Nopcsa² and emended by Gilmore³.

In the arrangement of the dermal scuta of the skull, *Pinacosaurus grangeri* shows many resemblances to *Euoplocephalus* and *Dyoplosaurus*. The presence of large projecting dermal scutes on the postero-lateral angles, a row of ornate border ossifications above and overhanging the orbits, and the large triangular plate that extends downward and outward from the quadrato-jugal region are all features held in common. Likewise close resemblances are to be found in the form and denticulation of the teeth and in the structure of the palate and lower jaw.

Order SAURISCHIA

The occurrence of saurischian Dinosauria in eastern Asia was first announced by Osborn⁴ when he described *Asiatosaurus mongoliensis* from the Oshih formation. In addition to the type materials, mention is also made of a number of other occurrences in this same formation. In 1929, Wiman⁵ described *Helopus zdanskyi*, a new genus and species founded on an excellent skeleton from Shantung, China.

¹Sternberg, C. M. 1923. Trans. Roy. Soc. of Canada, XXII, pp. 102-104, Pl. III, figs. 2, 3, 4 and 5.

²Nopcsa, F. Baron. 1929. Dinosaurierreste Geologica Hungarica, Budapest, Pt. 5, p. 70.

³Gilmore, Charles W. 1930. Proc. U. S. Nat. Mus., LXXVII, Art. 16, p. 30.

⁴Osborn, H. F. 1924. Amer. Mus. Novitates, No. 128, p. 2.

⁵1929. Palaeontologia Sinica, Sec. C., VI, Pt. I, Geol. Survey of China, pp. 6-40, Pls. I to IV.

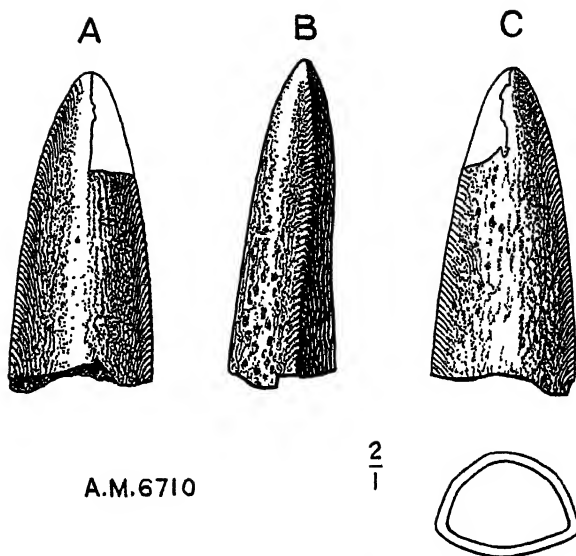


Fig. 4. Tooth crown of *Mongolosaurus haplodon*. Type. No. 6710, A. M. N. H. A, outer; B, edge, and C, inner views. Twice natural size.

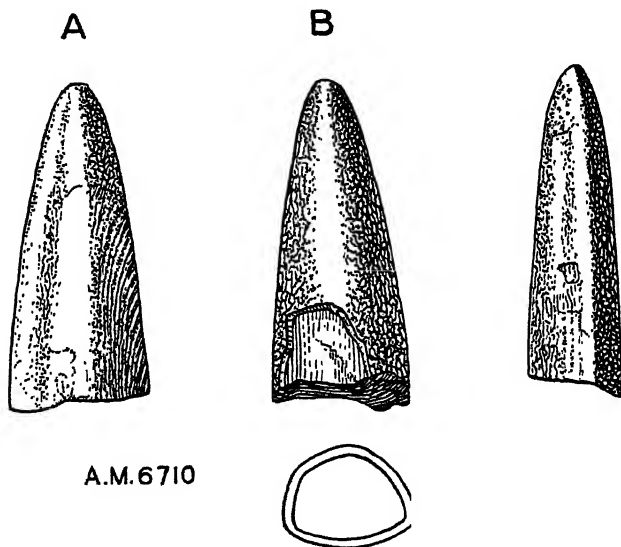


Fig. 5. Tooth crown of *Mongolosaurus haplodon*. Type. No. 6710, A. M. N. H. A, outer; B, inner, and C, edge views. Twice natural size.

The fragmentary specimen about to be described not only represents a new genus and species but is of further interest in being the only dinosaur known at this time from the On Gong formation.

Specimens observed in the field show the presence of saurischian dinosaurs in the Ondai Sair and Ochungchelo formations.

Mongolosaurus haplodon, new genus, new species

TYPE:—No. 6710, A. M. N. H., consists of the basioccipital, fragmentary teeth, atlas, fragmentary axis and third cervical vertebra. Collected by Walter Granger, June 3, 1928. Field No. 714.

LOCALITY:—Hu Khung Ulan, Inner Mongolia.

HORIZON:—On Gong, Lower Cretaceous.

Although fully recognizing the paucity of the type materials, the teeth found associated with the bones are so unlike those of any previously known sauropod that I consider it justifiable to propose the new genus and species **Mongolosaurus haplodon** for their reception.

It would seem that little question can be raised as to the proper association of these teeth, as they were found mingled with the bones, and also since this is the only dinosaur so far found in the On Gong formation.¹

TEETH:—Among the tooth fragments preserved with this specimen are portions of five crowns and numerous fragments. All of these are tapering and obtusely pointed. Somewhat flattened, on what is regarded as the inner side, the outer is angularly rounded. On either side where these two surfaces meet, a low longitudinal ridge or carina is developed which extends to the apex of the crown. These carinae on one tooth are faintly serrate (see fig. 4); on another (see fig. 5) no trace of serration is found. The roots appear to have been cylindrical as in *Diplodocus*. The crowns are covered with a thin enamel, irregularly striated. The pulp cavity is continued to the top of the crown. One tooth shows wear on the tip of the crown. The largest and best preserved crown has a greatest diameter of 9 mm., a least diameter of 7 mm. These slender teeth have their nearest resemblances in those of *Diplodocus* and *Pleurocoelus*. The more pointed crown with faintly serrate borders, however, at once distinguishes them, as the teeth of both genera mentioned above are slightly spatulate without trace of serration. It is quite impossible to determine from these detached teeth whether they pertain to the upper or lower dental series.

BASIOCCIPITAL:—The detached basioccipital bone is all that is preserved of the skull of this individual. It comprises the large hemi-

¹Andrews, R. C. 1932. Nat. Hist. of Central Asia, I, p. 378.

spherical condyle and heavy descending basioccipital processes. Its principal features are clearly shown in figure 6. The exoccipitals probably participate in the formation of the occipital condyle, but the sutures have so fully coalesced that no trace of their union is now visible. The condyle has a greatest transverse diameter of 54.5 mm., a greatest vertical diameter of 45 mm.

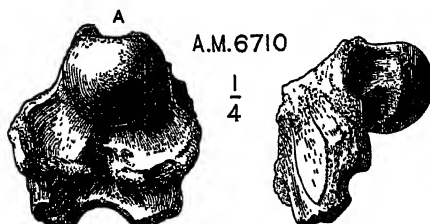


Fig. 6. Basioccipital of *Mongolosaurus haplodon*. Type. No. 6710, A. M. N. H. A, posterior view; B, lateral view. One-fourth natural size.

ATLAS:—The atlas consists of the usual four elements, the neurapophyses being firmly coössified with the intercentrum, and the odontoid with the anterior end of the axis. The intercentrum is relatively wider than the atlas of *Diplodocus*, more deeply excavated on the ventral

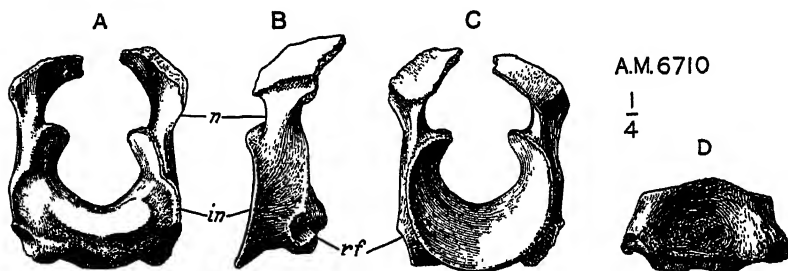


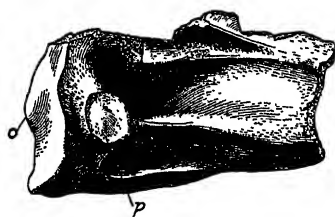
Fig. 7. Atlas of *Mongolosaurus haplodon*. Type. No. 6710, A. M. N. H. A, posterior view; B, lateral view; C, anterior view; D, ventral view. *In*, intercentrum; *n*, neurapophyses; *rf*, facets for cervical rib. All one-fourth natural size.

surface, and the neurapophyses are more constricted above the base than in that genus. The posteriorly directed portions of the neurapophyses or postzygapophyses are missing. The characters of the atlas are clearly shown in figure 7.

MEASUREMENTS OF ATLAS

Greatest length of intercentrum.....	43 mm.
Greatest width of intercentrum.....	89
Greatest height over all.....	125

Axis:—The centrum is all that is preserved of the axis. It is cupped posteriorly with a slight indication of a ball on the anterior end, in all probability the coalesced odontoid of the atlas complex. The anterior end is widely expanded, due to the development on either side of heavy parapophysial processes. These processes placed on the mid-height of the centrum project outward and backward and have a flattened articular



A.M.6710

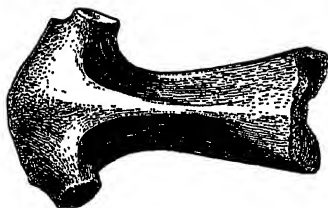


Fig. 8. Axis of *Mongolosaurus haplodon*. Type. No. 6710, A. M. N. H. A, lateral, B, ventral views. O, odontoid of atlas; p, parapophysial facet for cervical rib. One-fourth natural size.

end. Immediately posterior to this process, the side of the centrum is deeply excavated by cavities, one above the other. The upper is separated from the lower by a horizontal plate or lamina that anteriorly gives support to the parapophysial process. There is no evidence of a true pleurocentral cavity in the centrum such as occurs in *Camarasaurus* and *Diplodocus*.

From below, the centrum presents a transversely rounded surface at either end, connected by a thin keel which gradually widens toward the anterior end. The principal characters of the axis are shown in figure 8.

MEASUREMENTS OF AXIS

Greatest length of centrum.....	180 mm.
Greatest width of anterior end.....	117
Greatest width of posterior end.....	72

THIRD CERVICAL:—The third cervical is strongly opisthocoelous. It is essentially complete and but little distorted. The anterior as well as the posterior zygapophyses are widely expanded and the former strongly overhangs the ball of the centrum. Near the anterior end on either side of the centrum, a strong process springs from the inferior lateral border.

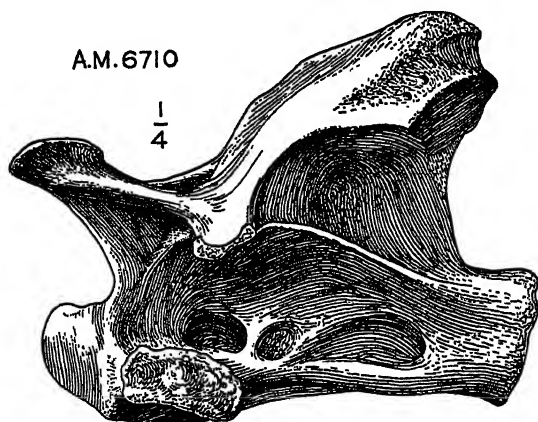


Fig. 9. Third cervical vertebra of *Mongolosaurus haplodon*. Type. No. 6710, A. M. N. H. Viewed from left side. One-fourth natural size.

The extremity of this process expands into a capitular facet for the articulation of the capitulum of the cervical rib. In this vertebra the lower surfaces of these processes are on a level with the bottom of the centrum, whereas in *Diplodocus*, *Helopus* and especially in *Haplocanthosaurus* they are produced far below the inferior side of the centrum. The presence in the cervical region of bifid spinous processes is apparently indicated by incipient parallel ridges that appear on either side of the median dorsal surface and that terminate posteriorly as two bluntly rounded projections that overhang the posterior border between the

zygapophyses. In this respect the third cervical differs from those of *Diplodocus*, *Helopus* and *Camarasaurus*, which have well indicated spines on the third cervical. There are no true pleurocentral cavities, thus resembling *Helopus*. On the side toward the anterior end of the centrum above the base of the capitular processes, cavities lead in toward the ball,

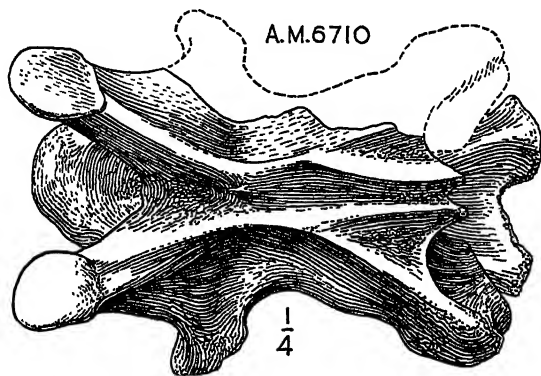


Fig. 10. Third cervical vertebra of *Mongolosaurus haplodon*. Type. No. 6710, A. M. N. H. Viewed from above. One-fourth natural size.

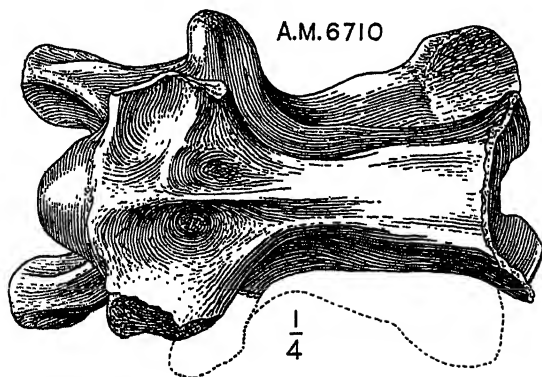


Fig. 11. Third cervical vertebra of *Mongolosaurus haplodon*. Type. No. 6710, A. M. N. H. Viewed from below. One-fourth natural size.

a feature apparently present in all sauropod cervicals. On the left side is a small subcircular cavity separated from the cavity described above by a slender vertical bar of bone. There is no evidence of a similar opening on the right side. Viewed from below, the anterior end appears broadly expanded with a low median keel on the anterior third, on either

side of which the surface is shallowly excavated. The ventral surface of the posterior portion is flattened, slightly constricted transversely at the center and expanded at the posterior end to form the cup. The left diapophysis is slender and lacks its articular end. It is supported by the usual laminae. The principal characters of this cervical are clearly shown in figures 9, 10 and 11.

MEASUREMENTS OF THIRD CERVICAL

Greatest length of centrum.....	263 mm.
Greatest height of vertebra.....	208
Greatest width of anterior end.....	140
Greatest width of posterior end.....	100
Greatest spread of anterior zygapophyses.....	140

RELATIONSHIPS:—Little can now be said of the relationships of *Mongolosaurus haplodon*. That it is a true member of the Sauropoda is abundantly indicated by the few bones of the type specimen preserved, all of which are typical of that group. At the present time it is on the tooth characters that we must largely rely for distinguishing this from the previously described members of the order, since the lack of homologous parts renders proper comparison of the bones with those of many of the described genera out of the question.

The teeth, however, are so unlike any of the previously known spatulate sauropod teeth that the generic distinction of this form appears obvious.

The family relationships of *Mongolosaurus* must await the evidence afforded by more perfect material.

NOTES ON OTHER DINOSAURIAN OCCURRENCES IN MONGOLIA

Family **DEINODONTIDAE**

The presence in the Djadochta formation of a large member of the theropodous Dinosauria is indicated by a fragmentary portion of a right ilium (No. 6522, A. M. N. H.). This bone, consisting of the lower third of the anterior part of the blade and much of the acetabulum, lacking the greater peduncle, indicates an animal the size of *Gorgosaurus* of the American Upper Cretaceous, and it might very well pertain to the family Deinodontidae, but the fragmentary condition of the material precludes a positive confirmation of that suggestion. As recording the presence of a large member of the Theropoda in the Djadochta formation, this specimen is at least of interest.

A fragmentary specimen, No. 6592, A. M. N. H., collected by G. B.

Barbour from a bone bed on the Wanchuan Trail, above Kalgan, is clearly recognizable as pertaining to the Theropoda. This specimen is evidently the one referred to in Granger's letter¹ to me of Jan. 18, 1930, as "some fragments of small dinosaurs from Barbour's 'Nantienmen' Cretaceous beds of the Kalgan area, North China."

Among the fragments the following elements are recognized: An incomplete crown of a compressed tooth having a serrate posterior border, tip portion of an ungual phalanx, proximal end of ulna, half of a cervical vertebra, parts of several phalanges, and shaft portions of both pubes. These portions of the skeleton indicate an individual of about the stature of *Ornithomimus asiaticus*, but the presence of a tooth apparently indicates its distinctness from that form. The chief interest of the present specimen is that it records a new locality for carnivorous dinosaurs in North China, and in all probability an undescribed member of the Theropoda.

A second specimen, No. 2906, A. M. N. H., field No. 107, consisting of an incomplete sacrum, fragmentary portions of the ilia, pubes, ischia, parts of dorsal and caudal vertebrae, proximal end of radius, and many fragments, was collected 17 miles N.W. of Kalgan on the road to Wanchuan Hsien Pass by Morris and Barbour, October 11, 1925. Under date of Nov. 30, 1932, Granger wrote me: "The Barbour specimen came from the same locality and horizon and may even be a part of the same individual, although it was collected two or three years later."

The two specimens are essentially of the same size, and I find no duplication of parts. The character of fossilization is identical, so that they might very well, as Granger has suggested, pertain to the same individual.

Family **ORNITHOMIMIDAE**

A fragmentary specimen, No. 6593, A. M. N. H., consisting of the proximal third of Mt. IV, a dorsal centrum, parts of two caudal centra and two phalanges of the hind foot, records a new locality for the Ornithomimidae in Mongolia. The specimen, field No. 804, was collected by Horwath, July 26, 1928, in Tairum Nor Basin on the south side of Tairum Nor Lake. The bones were associated and presumably pertain to a single individual; although one cannot be positive on such fragmentary evidence, they appear to be referable to the family Ornithomimidae, and the close resemblance of these bones to homologous

¹Gilmore, Charles W. 1931. 'Fossil Turtles of Mongolia.' Bull. Amer. Mus. Nat. Hist., LIX, p. 248.

elements of the *Ornithomimus asiaticus* skeleton strongly implies their being congeneric. On the other hand, they might, if homologous elements were available for comparison, with equal propriety pertain to the genus *Oviraptor*. Since the family Ornithomimidae is not known to occur outside of the Upper Cretaceous, assumption would be that the beds from which this specimen came are of that age and furthermore equivalent to either the Iren Dabasu or Djadochta, although as Doctor Granger informs me the nearest known outcrops of those formations are 75 miles distant.

Family **HADROSAURIDAE**

A specimen. No. 6594, A. M. N. H., field No. 565, consisting of a mid-portion of a dentary, fragment of a surangular, a phalangeal bone of the pes and portions of three anterior caudal vertebrae, is regarded as pertaining to a member of the Hadrosauridae. Of its predentate affinities there is no doubt; the piece of a dentary showing grooves for the rows of teeth is sufficient evidence in itself. This conclusion is further substantiated by the fragment of the surangular and the foot bone. The caudal centra are large, subround in outline and have a close resemblance in length and form to those of *Hypacrosaurus*¹ figured by Brown. It appears that all of these bones may very well pertain to a single individual, and fragmentary as the evidence may be, it points to hadrosaurian relationships.

This specimen was collected by Walter Granger, July 27, 1929, about 75 miles northeast of Shabarakh Usu, Outer Mongolia, from the Dohoin Usu formation, and is of interest as recording the most ancient occurrence of hadrosaurian dinosaurs yet found in Mongolia.

A caudal centrum and two incomplete ribs, No. 6595, A. M. N. H., field No. 508, are identified as pertaining to a hadrosaurian dinosaur. These specimens were collected at Baiying Bologai by George Olsen, May 5, 1925. In a recent letter, Granger sends me the following extracts from his field notes concerning them.

"The centrum was one of several dinosaur bones found in at least four places—a femur four feet long without either end, a fragment of a presacral vertebra and one or two unrecognizable bones. Found in coarse red sandstone. A few additional bones taken on return journey, August."

¹Brown, Barnum. 1913. Bull. Amer. Mus. Nat. Hist., XXXII, Art. XX, fig. 3, p. 400.

The centrum, which appears to be an anterior caudal, pertains to a very large hadrosaurian. These specimens are of interest as being the only record of dinosaurian specimens known from the Baiying Bologai formation of the Lower Cretaceous.

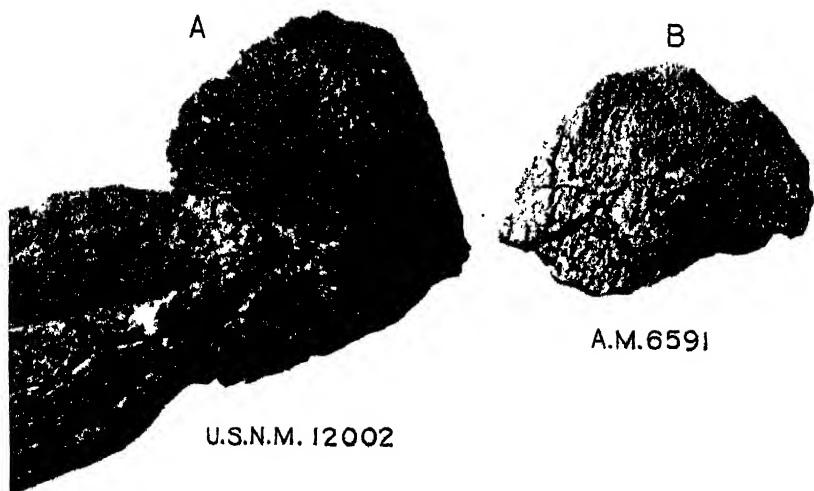


Fig. 12. Epoccipital bones compared. A, *Pentaceratops*, No. 12002, U. S. N. M.; B, Mongolian specimen, No. 6591, A. M. N. H. Both about one-third natural size.

Family CERATOPSIDAE

A single incomplete bone, No. 6591, A. M. N. H., which came to me associated with field No. 508, is regarded as pertaining to a member of the horned Dinosauria. The close resemblance of this bone in form and surface sculpture to an epoccipital (No. 12002, U. S. N. M.), provisionally referred to the genus *Pentaceratops*, leaves little doubt of its ceratopsian affinities. The specimen was collected by George Olsen, at Baiying Bologai, Mongolia, May 5, 1925.

It is a compressed bone with a bluntly sharpened edge. One side, probably the lower, is flattened, the opposite side being slightly convex antero-posteriorly. Both surfaces are sculptured by the characteristic pits and grooves of a bone that in life was covered by a horny skin. The base is incomplete, this entire border presenting a broken surface, and owing to the lack of this surface a positive identification of the bone is not possible.

If, however, the bone is correctly referred to the horned Dinosauria, it is of much interest as being the first indication of the presence in Mongolia of a large member of the Ceratopsia, as previously the relatively small *Protoceratops* was the only form recognized.

BIBLIOGRAPHY

- ANDREWS, R. C. 1932. Natural History of Central Asia, I, p. 378.
BROWN, BARNUM. 1913. Bull. Amer. Mus. Nat. Hist., XXXII, Art. 20, fig. 3, p. 400.
GILMORE, CHARLES W. 1930. Proc. U. S. Nat. Mus., LXXVII.
1931. Bull. Amer. Mus. Nat. Hist., LIX, Art. IV, p. 248.
1933. Bull. Amer. Mus. Nat. Hist., LXVII, Art. II, p. 75.
HUENE, F. v. 1932. Monog. zur Geologie und Palaeontologie, Leipzig, Ser. 1, IV.
NOPCSA, F. BARON. 1929. Dinosaurierresti Geologica Hungarica, Budapest, Pt. 5, p. 70.
OSBORN, H. F. 1924. Amer. Mus. Novitates, No. 128.
STERNBERG, C. M. 1928. Trans. Roy. Soc. of Canada, XXII, Sec. IV, pp. 93-106, Pls. I-III.
WIMAN, CARL. 1929. Palaeontologia Sinica, Ser. C, VI, Pt. I, Geological Survey of China.

THE STATUS OF *MINERVA ANTIQUA*, *AQUILA FEROX* AND
AQUILA LYDEKKERI AS FOSSIL BIRDS

BY ALEXANDER WETMORE

In study of fossil bird material in the American Museum of Natural History, R. W. Shufeldt in 1913 named three species that he considered fossil eagles,¹ namely, *Aquila antiqua*, *A. ferox*, and *A. lydekkeri* from the Bridger formation of the Eocene. Later² he decided that the first mentioned was an owl and set up the genus *Minerva* for it so that it became *Minerva antiqua*.

The fragmentary material on which these forms were based has appeared to me of doubtful identity, but until now there has not been opportunity for consideration of the species concerned except as they have come to attention in literature. Recently through Dr. Walter Granger the type specimens have been sent to me for study with results that are highly interesting.

The type of *Aquila antiqua*³ (A. M. 5163) is a claw, with the point broken away. Its principal peculiarity is the considerably elongated articular surface that describes the arc of a semicircle. On examination this claw proves to be from the foot of an edentate mammal, a conclusion in which I have been assisted by Dr. C. L. Gazin of the U. S. National Museum. The specimen is accompanied by an ungual phalanx bearing the same catalog number which is not mentioned by Shufeldt. This also is from an edentate mammal as is shown by the form of the deeply incised groove on the distal articular surface. *Minerva antiqua*, therefore, is to be eliminated from the avian list and transferred to the Mammalia.

The type of the second of these species, *Aquila ferox*⁴ (A. M. 5164), is a nearly complete claw, only the distal point being broken away. It also is from an edentate mammal, quite probably from the same species as *Minerva antiqua*, a conclusion in which also I have the concurrence of Dr. Gazin. It too must be removed from the list of fossil birds and transferred to the mammals. The resemblance of this species to *Minerva*

¹Bull. Amer. Mus. Nat. Hist., 1913, XXXII, August 4, pp. 297-298.

²Trans. Connecticut Acad. Arts Sci., 1915, XIX, February, p. 43.

³1913. *Aquila antiqua* Shufeldt, Bull. Amer. Mus. Nat. Hist., XXXII, August 4, p. 297, from the Bridger Eocene of Church Butte, Wyoming.

⁴1913. *Aquila ferox* Shufeldt, Bull. Amer. Mus. Nat. Hist., XXXII, August 4, p. 297, from the Bridger Eocene of Henry's Fork, Wyoming.

antiqua has been noted by Dr. Hildegarde Howard¹ from the original descriptions without advantage of examination of the material.

The case of *Aquila lydekkeri*² (A. M. 5165) is somewhat more complicated. The type material is composite, including a claw and three fragmentary phalanges from an edentate mammal, the distal end of a tibio-tarsus, the proximal end of a metatarsus, two bits from a femur, and a claw, from one or more species of birds, together with some miscellaneous fragments of uncertain identity.

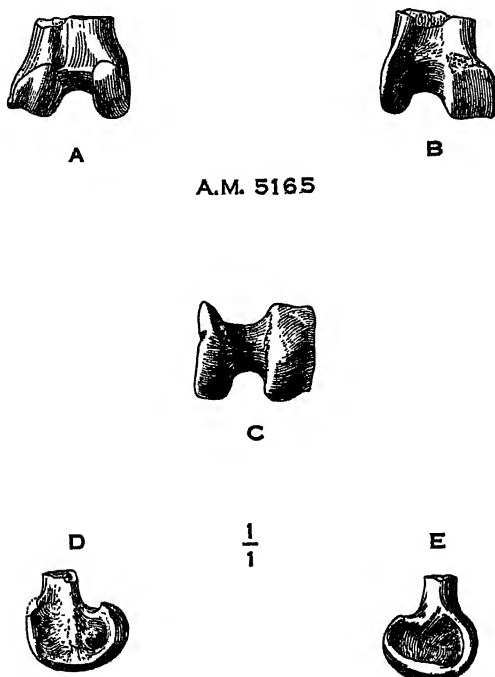


Fig. 1. *Protostrix lydekkeri* (Shufeldt). Type A. M. 5165. Distal end of tibio-tarsus. A. Anterior view; B. Posterior view; C. Distal end; D. Inner face; E. Outer face. Natural size.

After some study it appears that the distal end of the tibio-tarsus is the only avian specimen that may be successfully identified, it coming from a highly peculiar owl-like form. In the original description Shufeldt gives a general account of all this material without figuring any of it or

¹1932. Carnegie Institution of Washington Publ. 429, Oct., pp. 32-33, 75.

²1913. *Aquila lydekkeri* Shufeldt, Bull. Amer. Mus. Nat. Hist., XXXII, August 4, p. 298, from the Bridger Eocene of Lower Cottonwood Creek, Wyoming.

selecting any one specimen as type. After due consideration, to save this name I have selected the fragmentary bit of a tibio-tarsus as the type of *Aquila lydekkeri*.

For the species represented I propose the genus

Protostrix, gen. nov.

CHARACTERS.—Distal end of tibio-tarsus (fig. 1) generally similar to *Bubo*¹ but external condyle relatively much narrower; internal condyle much broader, with external margin flaring so that the outer part of the articular surface is shallowly grooved; on anterior face the external condyle not extended up the shaft as far as the internal condyle, instead of the reverse; a distinct tubercle on the outer face of the internal condyle for tendinal attachment; distal end of shaft less excavated on anterior face.

TYPE.—*Aquila lydekkeri* Shufeldt (part), which becomes *Protostrix lydekkeri* (Shufeldt).

DISCUSSION.—The intercondylar sulcus is deep, with the external condyle viewed from in front uniform in width back to the center of the sulcus, where it narrows to terminate in a flange-like process; outer surface excavated with the rounded edge of the articular surface projecting out over it; internal condyle broad and heavy and of nearly uniform width throughout, rising abruptly from the intercondylar sulcus; inner margin rounded, this slightly beveled articular surface extending outward to be flared upward slightly toward the external margin; on anterior face this condyle not extending as far up the shaft as the outer one; external face of this condyle irregularly excavated, with an elongated tubercle at its center that extends up onto the shaft; anterior face of lower end of shaft slightly excavated above the intercondylar sulcus; the two condyles generally similar in external contour. Bone well fossilized, in color, neutral gray, varied with an ashy white cast from adherent matrix.

The specimen has the following measurements: transverse breadth of lower end of shaft 11.8 mm., antero-posterior diameter of condyles 12.9 mm., greatest width of external condyle 4.6 mm., greatest width of internal condyle 6.3 mm.

While resembling modern owls of the order Strigiformes in lack of a supra-tendinal bridge, in similarity in size and outline of the two condyles, and in their position relative to one another, this bird differs from all in the lessened depression on the lower end of the anterior face of the

¹1806. *Bubo* Duméril, Zool. Analytique, p. 34. Type, *Strix bubo* Linnaeus

shaft, in the concave outline of the outer articular surface of the anterior condyle and in the tubercle on the outer face of the internal condyle. On these grounds it is placed in a separate family, the **Protostrigidae**, in the order Strigiformes. The tubercle mentioned is an approach to what is found in many other groups of birds. Dr. Hildegard Howard¹ also has commented on the strigine form of this tibio-tarsus as indicated by Shufeldt's statement regarding it.

Whether any of the other avian fragments associated with the selected type are from *Protostrix lydekkeri* is problematical because of their fragmentary condition. The writer ventures no opinion on this question.

There remains to consider the status of the fossil owl that I named *Minerva saurodosis*² some years ago from deposits of the Bridger Eocene near Fort Bridger, Wyoming. This is an owl-like form described from the distal end of a humerus intermediate in size between the barred owl *Strix varia* and the great horned owl *Bubo virginianus*. The bone is generally similar in outline to the same part in modern owls but differs appreciably in the lesser development of the trochlea and of the points of tendinal attachment in general.

From its peculiarities it may be placed in the family Protostrigidae as it is not typical of the living families Strigidae and Tytonidae. As the genus *Minerva* has been shown above to apply to a mammal since its type *Minerva antiqua* (Shufeldt) is found to be an edentate, the species *saurodosis* is left without a generic name. Comparison between *Protostrix lydekkeri* and *Minerva saurodosis* is obviously difficult as the first is based on a tibio-tarsus and the second on a humerus. Both show definite divergence from living owls and as a matter of convenience may be placed in the same genus pending additional information that will give further light on their relationship. *Minerva saurodosis* will therefore be listed as *Protostrix saurodosis* (Wetmore).

¹1932. Carnegie Institution of Washington Publ. 429, Oct., pp. 32-33, 75.

²1921. *Minerva saurodosis* Wetmore, Proc. Acad. Nat. Sci. Philadelphia, LXXIII (April 6, 1922), p. 455, figs. 1-2, near Lodge-Pole Trail Crossing on Dry Creek, about 10 miles from Fort Bridger.

AMERICAN MUSEUM NOVITATES

Number 681

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Dec. 30, 1933

59.9 (57.1)

MAMMALS COLLECTED IN THE MARITIME PROVINCE OF SIBERIA BY THE MORDEN-GRAVES NORTH ASIATIC EXPEDITION, WITH THE DESCRIPTION OF A NEW HARE FROM THE AMUR RIVER

By G. G. GOODWIN

The trip undertaken by the Morden-Graves Expedition in eastern Siberia during the winter of 1929-1930 was made primarily for a group of Siberian tigers for the North Asiatic Hall of The American Museum of Natural History.

Leaving the Trans-Siberian Railway at Khabarovsk on December 22, 1929, we travelled north for four days down the Amur by horse sleigh to Troitskov, and then east through the forest for three days, by dog teams, to the Monoma River, about eighty miles east of Troitskov. After a few days collecting there, we returned to Troitskov and then back about twenty miles along the Amur to Nykin; leaving the Amur here, we made a two days' journey by horse sleigh to the Mukhen River and the Sacred Tiger Rocks, using a lumber camp on the Nelta River as a base. Our next camp was in the Ussuri River region, thirty miles east of Bikin.

Acknowledgment is due to Mr. William J. Morden and Mr. George C. Graves, who organized and led the expedition and assisted the writer in collecting small mammals; also to Mr. H. E. Anthony for advice in comparing and identifying the specimens.

Sorex araneus borealis Kastschenko

Boreal Shrew

Sorex araneus borealis KASTSCHENKO, 1905, Bull. Imperial Tomsk University, XXVII, Tomsk, p. 86.

Two specimens. Nelta River.

This shrew is a fairly large brown species with the light color of the belly extending well up on the sides. Tail covered with stiff hairs and with a well-developed tuft of hairs at tip.

Color of upperparts between Prout's brown and mummy brown, paler on sides of body and head. Underparts silvery white washed with greenish buff; upper surface of feet and tail cinnamon-brown, tail paler below.

Skull relatively long and narrow; first and second unicuspid teeth about equal in vertical length; third and fourth smaller, the fourth only a fraction smaller than the third; fifth unicuspid small and crowded, but tipped with pigment.

Measurements of two specimens from Nelta River: total length, 110, 120 mm.; tail vertebrae, 35, 40 mm.; hind foot, 15, 15 mm. Skull: greatest length, 21, 21.5 mm.; greatest breadth, 9, 9 mm. Distance from tip of first incisor to back of last premolar, 6, 5.5 mm.

These two specimens are here referred to this species. I have not seen any typical specimens of *S. a. borealis*, but they appear to be as close to this species as any other described form.

***Sorex macropygmaeus annexus* Thomas**

Korean Shrew

Sorex annexus THOMAS, 1906, Proc. Zool. Soc. London, p. 859.

Ten specimens: Monoma River, 4; Nelta River, 5; Bikin River, 1.

The Korean shrew is a small brown shrew similar externally to *S. m. macropygmaeus* but differs from the latter in having a flatter skull, broader rostrum, and broader interorbital.

Color of specimens from Amur and Ussuri River region in winter pelage, upperparts nearest to Prout's brown without distinctly darkened dorsal area; underparts washed with brownish white; upper side of tail like back; under side of tail, upper surface of feet, brownish white.

Skull larger than *S. minutus* but smaller than *S. araneus*; first four upper unicuspid teeth evenly graduated in size backwards.

Measurements, average of five largest specimens from Monoma and Nelta Rivers: total length, 91 mm. (90–95); tail vertebrae, 35.8 mm. (35–37); hind foot, 12.8 mm. (12.5–13). Skull: condylobasal length, 17.7 mm. (17.5–18); greatest breadth, 8.4 mm. (8.1–8.7); length of upper toothrow, 7.5 mm. (7.4–7.7).

Although the type description of *S. annexus* does not enable me to define it satisfactorily, I am convinced that the above specimens are referable to this species.

***Sorex unguiculatus* Dobson**

Big-clawed Shrew

Sorex unguiculatus DOBSON, 1890, Ann. Mag. Nat. Hist., (6) V, pp. 155–156.

Nine specimens: Monoma River, 4; Nelta River, 2; Mukhen River, 2; Bikin River, 1.

The big-clawed shrew is a large dark-colored species with a relatively

short tail and is readily distinguished from other known species of *Sorex* found in eastern Siberia by the exceptionally large size of the front feet and claws. In general appearance this species resembles *S. araneus*. The tail is evenly covered with rather stiff short hairs, which do not form a pencil at extremity. The color in winter pelage is uniform mummy brown above, below whitish washed with pinkish buff; fore and hind feet covered with short, soiled whitish hairs; tail dusky above, paler below.

The skull is short with a broad brain case. The second upper incisor is the most vertically extended and the largest of the unicuspid teeth; the third unicuspid is about equal to or only a shade smaller than the second, but exceeds the fourth in vertical length; the fifth unicuspid stands in line of the toothrow and is tipped with pigment; it is about as much smaller than the fourth as the latter is than the third.

Measurements, average of five adult specimens from Monoma and Nelta Rivers: total length, 115 mm. (110-121); tail vertebrae, 43 mm. (40-50); hind foot, 15 mm. (14.5-16). Skull: greatest length, 20.3 mm. (20-21); greatest breadth, 10 mm. (10-10); distance from tip of first incisor to back of last premolar, 5.25 mm. (5.2-5.5).

This shrew was found in low forested country along the banks of slow-moving rivers. During the winter months it feeds to a large extent on frozen salmon that are frequently seen protruding through the ice. In a lumber camp that I visited for lunch I caught two of these shrews as they ambled over the rough hewn logs that formed the floor, in search of scraps of boiled fish dropped by the lumber men.

***Sorex gravesi* Goodwin**

Graves Shrew

Sorex gravesi GOODWIN, 1933, Amer. Mus. Novit., No. 657.

Two specimens: Monoma River.

The Graves shrew is a dark-colored shrew, about the size and external proportions of *S. araneus borealis*, but underparts dark blackish-brown; tail rather short, finely haired and tufted at tip; fore and hind feet large but not nearly so large as in *A. unguiculatus*.

Color of back dark mummy-brown, this color extending well over crown of head, sides, and down limbs to ankles; sides barely perceptibly paler than back; underparts mummy brown, very little lighter than back; feet snuff brown; tail about color of back above, below buffy at base but gradually shading darker toward tip which is dark all around; lips and chin soiled whitish.

Skull short with broad flattened brain case, the unicuspid teeth inclined forward, tips rounded and, viewed laterally, evenly graduated in size backward. The first unicuspid is the largest, the third is as much smaller than the second as the second is than the first, and the fourth is equally as much smaller than the third; the fifth unicuspid is smallest, evenly placed in the toothrow, tipped with pigment and relatively large.

Measurements: total length, 100 mm.; length of tail, 35 mm.; hind foot, 15 mm. Skull condylobasal length, 19.2 mm.; cranial breadth, 9.5 mm.; interorbital breadth, 4.1 mm.; palatal length, 8.1 mm.; maxillary breadth, 5.4 mm.; maxillary toothrow, 8.6 mm.; distance from tip of first upper incisor to back of last premolar, 5.6 mm.

Sorex gravesi may be distinguished from *unguiculatus* by its much smaller feet, finely haired and tufted tail, and dark-colored underparts. The dentition, however, is much the same, but the skull is proportionately smaller. The specimens were taken in low evergreen-forested country on the banks of the Monoma River, which eventually flows into the lower Amur.

***Sorex minutus gracillimus* Thomas**

Saghalien Pygmy Shrew

Sorex minutus gracillimus THOMAS, 1907, Proc. Zool. Soc. London, I, pp. 408-409.

Three specimens: Monoma River.

The Saghalien pygmy shrew is a very small species with a relatively long tail, similar in proportions to the smaller forms of European *S. minutus*.

Color of specimens in winter pelage from Monoma River: upperparts between mummy brown and sepia, the hairs slate gray at base and with silvery subterminal band giving rise to a grayish effect; underparts whitish washed with buff; sides not noticeably contrasted with back; tail hairy, sharply bicolor, above, color of back, below, wood brown; upper surface of feet wood brown.

Skull very light, delicate and narrowed in the facial region. In typical *S. minutus* the skull narrows evenly forward from the brain case, but in *S. m. gracillimus* the narrowing is much more abrupt in the interorbital region; p^1 and molar teeth rather narrower than in true *S. minutus*.

Measurements, average of three skins from Monoma River: total length, 86 mm. (83-90); tail vertebrae, 38 mm. (37-40); hind foot, 11.6 mm. (11.3-12). Two skulls: condylobasal length, 15.35-15.4 mm.; basal length, 13.7-13.7 mm.; greatest breadth, 7.1-7.1 mm.; inter-

orbital breadth at posterior end of anteorbital foramina, 2.6–2.65 mm.; upper toothrow, 6.65–6.6 mm.

The Monoma specimens apparently average smaller with a narrower brain case than the type which, however, was based on a skull without skin and, apparently, an old animal. In view of the lack of material for comparison and the inadequate description, it seems best to refer these specimens to Thomas' subspecies.

***Ursus arctos mandchuricus* (Heude)**

Manchurian Brown Bear

Ursus arctos mandchuricus HEUDE, 1898, Mém. Conc. l'Hist. Nat. l'Emp. Chin., IV, p. 23, Pl. 1.

One skull without skin: Nelta River, sixty miles north of Khabarovsk.

A large bear skull with well-worn teeth, purchased from the natives at a lumber camp, sixty miles north of Khabarovsk, is here provisionally referred to the above species. The brown bears of eastern Asia are rather imperfectly known. Gray's name (*lasiotus*) of 1867 appears to have been disregarded by later authors, but according to Lönnberg, it is applicable to the big bear of Mongolia and the interior of China. It is possible that this species is identical with *mandchuricus*, and, if such is the case, Gray's name has the priority. The question of identity of the two named forms can hardly be decided at the present time. Sowerby applied Heude's specific name *cavifrons* to a bear from North Kirin, Manchuria. In cranial measurements and characters described nothing prohibits the specific identity of this bear with the present specimen. Sowerby refers Heude's *cavifrons* to *Spelaeus*. As characteristic of the latter he mentions "very high forehead so that the cranial outline at this point is concave." The same is true of the present specimen. This character is very variable in other species of bears and there is a probability that the same is true here and the high brow may be an age character. The skull of *mandchuricus* is said to be large, long and narrow with a very slightly concave outline. The important skull characters mentioned by Gray as distinguishing the grizzly bears from the *arctos* group—a narrow palate constricted behind—are not mentioned for *cavifrons*, but if such should happen to be the case our Amur skull has nothing to do with it, because the latter has a broad palate not constricted behind the molars, and therefore belongs to the *arctos* group. Ognev accepts Heude's name, *mandchuricus*, and refers the big brown bear of northern Manchuria, Maritime and Amur districts, to this species.

Measurements: greatest length, 420 mm.; zygomatic breadth, 265 mm.; interorbital breadth, 118 mm.; width of palate inside p^2 , least width of palate behind molars, 47 mm.; distance from back of palate to front of incisors, 217 mm.; front of canine to back of last molar, 157 mm.; combined length of $p^4 m^1 m^2$, 85 mm.; length of m^2 , 42 mm.; width of m^2 , 24 mm.; length of lower jaw, 275 mm.

The specimen was killed on February 7, by natives, who found its tracks in the snow in zero weather. I saw a number of bear skulls hung up on branches at the outskirts of Tungus villages to drive away evil spirits. They were all small skulls, however, and probably of the *Selenarctos thibetans* group.

***Nyctereutes procyonides amurensis* Matschie**

Amur Raccoon Dog

Nyctereutes amurensis MATSCHIE, 1908, 'Wissens. Erg. der Exped. Filchner nach China und Tibet,' 10 Band, 1 Theil, p. 179.

One native skin without skull from fur-trading station at Troitskov.

The long loose fur, small ears, and short bushy tail give this species a superficial resemblance to a raccoon. Color of an adult male in winter pelage from Troitskov: underfur on back golden cinnamon-brown, long guard-hairs warm buff liberally tipped with black; crown of head mixed cinnamon-buff and black, darker between the eyes; end of nose soiled whitish; ears golden cinnamon-brown sparsely washed with black; sides of body paler than back, a broad black streak across the eyes to throat; a tuft of long buffy hairs on side of head below the ears; chin, throat, fore and hind feet blackish brown, rest of underparts brownish drab; tail about color of back above, below clear warm buff.

***Mustela sibiricus coreanus* (Domaneski)**

Corean Yellow Mink

Kolonocus sibiricus coreanus DOMANESKI, 1926, Ann. Zool. Mus. Polinici Hist. Nat., V, No. 1, p. 55.

Eight complete specimens and four skulls without skins: Monoma River.

The Corean yellow mink is a moderately large weasel-like animal with a comparatively long tail. Average color of specimens in winter pelage from the Monoma River; upperparts, including limbs and tail, ochraceous buff, some specimens a shade darker and richer in color, approaching ochraceous orange; underparts barely perceptibly paler than back; lips, chin, and end of muzzle white; face mummy brown,

this color very intense and extending backward from base of whiskers to well behind the eyes. Domaneski's description of *M. s. coreanus*, based on two mounted specimens, states that it resembles *M. sibiricus* Pallas in color of the body, but differs in the more intense brownish color on the face, which reaches farther posteriorly, encompassing the eye. I have not seen typical specimens of either *M. sibiricus* or *M. s. coreanus*, but the Monoma series agrees sufficiently well with Domaneski's brief description to be referred to this species until more adequate material is available.

Measurements of two largest males from Monoma River: total length, 535, 540 mm.; tail vertebrae, 205, 195 mm.; hind foot, 67, 69 mm. Skull: condylobasal length, 63, 63.6 mm.; zygomatic breadth, 34.6, 32.2 mm.; length of upper toothrow from front of canine to back of last molar, 18.5, 18.5 mm. Two females: total length, 460, 400 mm.; length of tail vertebrae, 160, 140 mm.; hind foot, 55, 55 mm. Skull: condylobasal length, 55, 54 mm.; zygomatic breadth, 26, 25.5 mm.; length of upper toothrow, 16.5, 16 mm.

***Vulpes vulpes beringiana* (Middendorf)**

Toondra Fox

Canis vulpes var. *beringiana* MIDDENDORF, 1875, 'Übersicht der Natur Nord-und-Ost-Siberiens,' IV, part 2, p. 990.

One native skin without skull from fur-trading station at Troitskov.

There are two principal color types of this wide-ranging fox, an intense red-orange phase and a pale-colored form. A native skin from Troitskov is here provisionally referred to this species. In color it is pale orange mixed with buff on upperparts, more reddish brown on the mid-dorsal area, and clearer and brighter on neck and shoulders; ears black; tail above about color of back, the tips of the long hairs black; end of tail white; sides of body clear warm buff; upper lips with a broad white edge; throat, chest, and central part of belly white; outside of limbs orange with a streak of blackish brown down front of metacarpals and metatarsals; inside of limbs irregularly creamy white.

***Panthera tigris amurensis* (Dode)**

Manchurian Tiger

Felis tigris var. *amurensis* DODE, 1871, Proc. Zool. Soc. London, p. 480.

Three specimens: two adult males and one small adult female from fifty miles east of Bikin. (Two males mounted for exhibition.)

In winter pelage the Amur tiger appears to be considerably more robust than the perennially short, smooth-coated Indian tiger, which, to some extent, may be attributed to its long fur. However, the northern tiger averages heavier and is more powerfully built than species from southern Asia, but not to the same extent as appearances at first glance would indicate. In summer pelage some specimens of the Amur tiger are very little paler than its southern relatives, and the stripes are equally distinct, but it often has considerably more white on the sides of the face, sides and under parts of body than the latter. The Amur tiger, as shown by material brought back by the Morden-Graves Expedition, is subject to a rather wide variation in the ground color of the pelage; one of the two adult males in winter pelage from fifty miles east of the Bikin Ussuri region is a rich dark yellow, while the other from exactly the same region is much paler and quite light-colored.

Dode, when describing *amurensis* as distinguishable from the Indian tiger by having longer fur, paler color, and less pronounced stripes, states that it occurs on the banks of the Amur and of its tributary, the Ussuri. He appears to have been in the northeast corner of Manchuria, and according to Pocock the western or left bank of the Ussuri in Manchuria may be taken as the type locality of *amurensis*, therefore specimens taken fifty miles east of Bikin should be fairly typical.

Measurements of two males and one female respectively: total length, 10 feet, 9 feet 7 inches, 9 feet 3 inches; tail vertebrae, 3 feet 7 inches, 3 feet 8 inches, 3 feet 7 inches; hind foot from calcaneum to foot pads, 12 inches, 12 inches, 6½ inches; height at shoulder, 3 feet, 2 feet 8 inches, 2 feet 6 inches; weight, 506 lbs. (230 kilograms), 440 lbs. (200 kilograms), 368 lbs. (167 kilograms). Skulls of two adult males: greatest length, 345 mm., 335 mm.; zygomatic breadth, 237 mm., 237 mm.; condylobasal length, 308 mm., 315 mm.; interorbital constriction, 67 mm., 66 mm.; length of palate, 160 mm., 145 mm.; length of nasals, 110 mm., 99 mm.; length of upper toothrow from front of canine to back of last molar, 104 mm., 103 mm.

The three specimens brought back by the expedition were killed with trap guns. These are smooth-bore single-barrelled shotguns loaded with slugs, set up on stakes a few feet from where animals are known to pass. A piece of string or fine wire is stretched across the trail about a foot above the snow, from a tree on the opposite side to a piece of wood pivoted to the stock of the gun and attached to the trigger. A large animal, following the trail, strikes the string and the gun is discharged. Tiger trails were common fifty miles east of Bikin but less frequent at

localities visited farther north. On the Monoma River, east of Troitskov, we saw only one single trail where a tiger had passed through that country. Tracks at Bikin consisted of some well-worn trails, usually situated along the foot of high ridges and extending for many miles. These consisted of a series of holes in the snow where the snow was packed down about the size of a man's foot. In suitable hunting sections the tiger apparently leaves the main trail in search of its prey. The staple food of the tiger in winter is wild boar, and all the droppings I found consisted of 100 per cent boar hair. They also kill a number of other animals. We found the frozen carcass of an adult wapiti apparently pulled down by a tiger, but very little of it was eaten, and one specimen which the expedition obtained had a piece of horsehide in its stomach.

***Panthera pardus orientalis* (Schlegel)**

Amurland Panther

Felis orientalis SCHLEGEL, 1857, 'Handleitung der Dierkunde,' I, p. 23, Pl. II, fig. 13.

Two skins without skulls: Okiansk, Ussuri District, 1; Nikolsk Ussuriiskii, 1.

The Amurland panther is a pale-colored species with full soft fur and long bushy tail, differing from the ordinary Asiatic form in having much longer fur and larger spots. The skins of two specimens killed near Vladivostok agree closely with the type description of *Felis villosa* from Amur Bay, which is considered by Pocock as a synonym of *P. p. orientalis*. The ground color of these two specimens is creamy buff; the rosettes are large, few in number, well spaced, without noticeably darkened centers, and showing up very strongly against the pale hue of the interspaces; large spots on flanks measure about 2" × 2" and interspaces up to about 2"; throat, belly and inside of limbs white, evenly studded with large black spots; head slightly paler than back, with smaller spots. The female is a shade lighter in color than the male with closer pelage and smaller spots and rosettes.

The two specimens are without skulls. One is a large male shot by a policeman while it was killing a dog on a skating pond near Okiansk, Ussuri District, in February, 1930. The leopard seized and killed the dog in the midst of many children. The other is a female killed by a trap gun set for tigers near Nikolsk Ussuriiskii, January, 1930. The two, it is stated, were the only ones seen in the Fur Exporting Department at Vladivostok.

Measurements of tanned skins (cased): male, total length, 2040 mm.; length of tail, 730 mm. Female, total length, 1950 mm.; length of tail, 830 mm.

***Sciurus vulgaris mantchuricus* Thomas**

Manchurian Pine Squirrel

Sciurus vulgaris mantchuricus THOMAS, 1909, Ann. Mag. Nat. Hist., (8) IV, p. 501.

Six specimens: Monoma River, 1; Nelta River, 1; Troitskov, 1 native skin; Barracks, twenty miles east of Troitskov, 2 skins and 3 skulls.

The Manchurian pine squirrel is the largest of the eastern Siberian squirrels. In winter pelage it has long well-developed ear tufts and a large bushy tail. Color of the type specimen in winter pelage; blackish gray with scarcely a trace of rufous; ear tufts black; tail black with inferior surface nearly as uniformly dark as the superior, without rufous tinge. Throat, belly, and arms creamy white. Skull conspicuously larger than any other of the eastern races of *S. vulgaris*.

Four specimens from the Amur River region about two hundred miles north of Khabarovsk agree with the type description in size and general characters, but are apparently somewhat paler and more grizzled in color. One specimen, a native skin without skull, is soiled yellowish white with brownish ear tufts and tail.

Measurements of two specimens, one from Monoma River, and one from the Barracks, 20 miles east of Troitskov, with type measurements in parenthesis: total length, 430, 390 mm. (455); tail vertebrae, 195, 190 mm. (205); hind foot, 65, 65 mm. (61). Skull: condylobasal length, 50.4, 50.2 mm. (52.3); zygomatic breadth, 33, 31.9 mm. (33.5); upper molar series, 10, 10 mm. (9.6).

Squirrels from the Amur region are much sought after by the fur trade owing to their large size and good color. Every native man and boy and many hunters from the neighboring cities spend the early part of the winter hunting squirrels. At the fur-trading station at Troitskov I saw several large bales of squirrel skins containing many thousands of specimens.

In the forest, squirrels are extremely shy and, toward Christmas, are very scarce. They apparently feed principally on the seeds of pine and fir cones and tracks were frequently seen in the snow.

***Pteromys russicus aluco* (Thomas)**

Maritime Province Flying Squirrel

Sciuropterus aluco THOMAS, 1907, Proc. Zool. Soc. London, II, pp. 464-465.

One complete specimen and one skull without skin: Nelta River, 1 skull (immature); fifty miles east of Bikin, 1 skull and skin.

The Maritime Province flying squirrel is a small nocturnal squirrel with soft downy fur, large eyes, flat buffy tail, and loose-furred skin extending from fore feet along sides of body. In size and color it is intermediate between typical *P. russicus* and *P. momonga*.

Color of upperparts buffy drab, not so strong as in *momonga*, nor of such clear gray as in *russicus*. Upperparts of hands and feet gray, the light hairs on the toes cream-color; tail pinkish buff, the intermixed black hairs of the upper layer usually few in number and therefore not hiding the buff. Skull narrow, sides of muzzle parallel and less expanded anteriorly than in *P. russicus*. Palatal foramina rather long. Bullae larger than in *momonga*, decidedly smaller than in *russicus*. Cheek teeth very small.

Measurements of adult female from thirty miles east of Bikin, with type measurements in parenthesis: total length, 245 mm. (306); tail vertebrae, 110 mm. (149); hind foot, 34 mm. (35). Skull: greatest length, 36.8 mm. (39); condylobasal length, 33.8 mm. (—); zygomatic breadth, 23 mm. (23); length of upper molar series, except pm³, 6 mm. (6.5).

Flying squirrels, though apparently fairly common in the regions visited, were difficult to trap. It is probable that during the coldest period of the winter, when most of my collecting was done, they do not move around much.

The specimen collected east of Bikin agrees closely in color and in general characters with Thomas's description of *P. aluco*, and it seems referable to that form, though the measurements of this specimen average a shade smaller.

The name *russicus* is used here for the Russian flying squirrel in preference to *volans*, which is restricted to American forms. The primary basis for *Mus volans* of Linnaeus was Ray's *Sciurus americanus volans* ('Quadr.', p. 215, 1693) which was undoubtedly founded on the American species. (See Howell, A. H., 1918, 'North American Fauna,' No. 44, p. 19.)

***Clethrionomys rutilus amurensis* (Schrenck)**

Amur Red-backed Mouse

Mus amurensis SCHRENCK, 1859, 'Reise Amur-lande,' I, p. 129.

Fourteen specimens: Monoma River, 5; Nelta River, 9.

The Amur red-backed mouse is a small pale-colored form with long soft pelage and short hairy tail. Color of specimens from Monoma River in winter pelage: dorsal area reddish orange-cinnamon; flanks, cheeks and front of head warm buff; the pale lateral area extends well up over sides to shoulders and face. Tail sharply bicolor, above, color of back, under side warm buff; underparts buffy white; fore and hind feet white.

Skull small with slender arches and more or less rounded loops on molars, but otherwise similar in general characters to other species of *C. rutilus*, with three well-developed, and in some instances four, folds in third upper molar. The reëntrant fold on the anterior side of the first lower molar in the type specimen of *C. amurensis* is probably due to individual variation, as one specimen from the Monoma River has similar folds in the first upper molars with well-formed grooves down the front of the teeth; some other individuals have a faint suggestion of similar folds.

Measurements, average of 5 adult specimens from Monoma River, with the type measurements in brackets: total length, 121 mm. (105–150) [138]; tail vertebrae, 24 mm. (20–27) [37]; hind foot, 19 mm. (18–20) [18]. Skull: condylobasal length, 22.6 mm. (22–23); zygomatic breadth, 12.8 mm. (12–13); length of upper molar series, 4.9 mm. (4.5–5).

The Monoma River is about two hundred miles south of Nickolivsk, the type locality for *C. amurensis*, and specimens collected here and on the Nelta River, a little farther south, agree sufficiently well with the type description to be referable to this species, which, in the writer's opinion, should be considered as a subspecies of *rutilus*. Specimens were taken in low tamarack swamp along with the larger and darker-colored *Clethrionomys arsenjevi*.

***Clethrionomys rufocanus arsenjevi* (Dukelski)**

Arsenieff Red-backed Mouse

Evotomys (*Craseomys*) *arsenjevi* DUKELSKI, 1928 (May 15), Zool. Anzeiger, Band 77, Heft ½, p. 40.

Thirty-three specimens: Monoma River, 17; Nelta River, 16.

A series of red-backed mice from the Monoma and Nelta Rivers are referred here provisionally to the above species. In color they apparently agree fairly closely with the type description: winter pelage, upper-

parts uniform rusty brown between tawny and cinnamon, face and sides of body grizzled (mixed pale buffy and black hairs); underparts washed with pale buffy; feet soiled whitish, tail dusky above, buffy below. In cranial measurements they average slightly larger than the type, but agree with the latter in having angular and heavily constructed zygomatic arches, short rostrum, broad brain case, molar toothrow lengthened, last upper molar with two well-developed folds on inner side.

I have not been able to find a description or type locality for *E. ussuriensis* Ognev.¹ Later authors appear to have disregarded this name more or less, but if Ognev's type was a specimen from the Ussuri region and of the *rufocanus* group, this name probably would be applicable to the present series.

Measurements, average of five adult specimens from Monoma River, with type measurements in brackets: total length, 135 mm. (130-136) [144.7]; tail vertebrae, 30 mm. (25-32) [30.2]; hind foot, 20.5 mm. (20-21) [18.3 without claws]; condylobasal length, 25.4 mm. (25.-25.8) [24.3]; zygomatic breadth, 14.7 mm. (14.2-15) [14.2]; upper molar series, 6.2 mm. (6-6.6) [6.2].

The type of *C. arsenjevi* was described as from seventy-five versts northeast of Vladivostok, collected June 22, 1927, and apparently in summer pelage, while our specimens were taken in mid-winter; therefore a discrepancy in color could be expected. The skull of the latter, however, averages larger and possibly more massive than the type, but general characters are approximately the same. In the present series the presence of a fourth outer reentrant angle on m^3 is most noticeable when viewed from the side and only indicated on the crown of the tooth by a slightly concave outline at this point. The additional angle can be seen definitely only in a few individuals of the present large series. The posterior lobe of m^3 correlating with the extra fold is relatively short and rounded but more or less drawn out when the extra fold is not present. Both skins and skulls of our specimens approach *C. rufocanus* and the author considers this form as a Ussurian subspecies of that group.

Mus (Alsomys) major rufulus Dukelski

Ussuri Wood Mouse

Mus (Alsomys) major rufulus DUKELSKI, 1928 (May 15), Zool. Anzeiger, Band 77, Heft ½, p. 44.

Three specimens: Monoma River, 1; Nanke, 1; Nelta River, 1.

¹ I. I. Ognev writes under date of November 28, 1933, in a letter to the author: ". . . *The Eutamias ussuriensis* is a *nomen nudum*. I had the project to describe *Eutamias ussuriensis*, but this project was not realized for want of material."

The Ussuri wood mouse is a relatively large tawny mouse with a long tail and large ears. It is larger and more reddish than the typical form. Color of type in summer pelage: upperparts uniform, between buckthorn brown and sayal brown and without dorsal stripe; fore and hind feet white; underparts white; tail bicolor, blackish brown above, soiled white below. Specimens from the Amur River region in winter pelage apparently are paler than the type specimen, with underparts creamy white.

Skull relatively heavy, rostrum elongated, zygomatic arches wide.

Measurements, average of three adult male specimens from Monoma River, Nelta River, and Nanke, with type measurements in brackets: total length, 190.7 mm. (180–197) [233.6]; tail vertebrae, 91.7 mm. (85–95) [111.5]; hind foot, 26 mm. (25–27) [24.9, without claws]. Skull: condylobasal length, 25.9 mm. (25.9–26) [24.2]; zygomatic breadth, 14 mm. (14–14.2) [14.8]; upper molar series, 4 mm. (3.8–4.2) [4.2].

The three specimens collected are referred here provisionally to *M. major rufulus*. They are from three different localities but from a similar environment and, while they show considerable individual variation and average slightly smaller than the type, they apparently agree in all essential characters with this subspecies.

This mouse was difficult to trap in the regions visited during the months of January and February, which, however, may have been due to the excessive cold.

***Rattus norvegicus caraco* (Pallas)**

Transbaikalia Brown Rat

Mus caraco PALLAS, 1778, 'Nov. Sp. Glir.,' pp. 91, 335, Pl. xxiii.

One specimen: Don Don River.

The native brown rat of Transbaikalia is similar in general characters to the typical Norway rat, but smaller. The hind foot of the Transbaikalian rat measures about 35 mm. as compared with 40 mm. or more in the typical form. The skull is also smaller than the latter. Summer pelage about as in *R. n. norvegicus*. Color of an adult male in winter coat from the Don Don River, fifty miles east of Troitskov, is much paler; upperparts ochraceous buff washed with brown-tipped guard hairs, paler on sides of body; underparts warm buff; fore and hind feet white; tail dusky above, whitish below. The fur in this specimen is long, soft and full.

Measurements: total length, 300 mm.; tail vertebrae, 150 mm.; hind foot, 38 mm. Skull: greatest length, 44 mm.; zygomatic breadth, 22.9 mm.; interorbital constriction, 6 mm.; length of upper molar series, 7.2 mm.; width of brain case back of zygomatic arches, 16 mm.

The range of the Transbaikalian brown rat is imperfectly known, and available material for comparison is limited. The present specimen is an old male with well-worn teeth. It averages slightly larger than the measurements for typical *R. n. caraco*, but the skull is decidedly smaller, with a narrower brain case than that of *R. n. norvegicus* at the same age.

The single specimen was taken on the banks of the Don Don River, ten miles from the nearest native village and fifty miles from Troitskov and the Amur, and apparently living under natural conditions.

***Lepus timidus mordeni*, new subspecies**

TYPE.—No. 85408, Amer. Mus. Nat. Hist.; ♂ ad.; Monoma River, eighty miles east of Troitskov, Maritime Province, eastern Siberia; January 16, 1930; collector, George G. Goodwin. The type is a skin and skull in good condition.

GENERAL CHARACTERS.—A large hare, similar to *Lepus timidus gichiganus* Allen and *Lepus t. orii* Kuroda, but distinguishable from both by its shorter skull and larger dentition.

DESCRIPTION.—Winter pelage pure white to extreme base of under fur. Ears tipped with black.

Skull relatively small with narrow rostrum and nasals; rather flattened brain case; postorbital constriction narrow; bulla small but well rounded; supraorbital process long and gradually tapering posteriorly to a narrow neck; molar and incisor teeth large and broad; though the skull is considerably smaller than in *gichiganus*, the teeth are actually larger, this character being most noticeable in the width of the lower incisors which are 3 mm. wide as compared with 2.5 mm. in *gichiganus*; the first upper premolar with two well-developed reentrant angles on its anterior surface, almost subequal, the interior angle only a fraction deeper than exterior angle; the crown is 5 mm. across instead of 4 mm. and 4.5 mm. as in *gichiganus*; other teeth are correspondingly greater in size than in the latter species; the largest upper molar is 6.5 mm. across the crown in the Monoma specimen as compared with an average of 5.7 (5–6) as in *gichiganus*. Compared with *L. t. orii* from Sakhalin the skull is smaller, especially in total length and zygomatic breadth.

MEASUREMENTS (taken in the flesh).—Total length, 570 mm.; tail vertebrae, 40 mm.; hind foot, 180 mm.; length of ear from notch, in dried skin, 37 mm. Skull: greatest length, 92 mm.; condylobasal length, 82 mm.; zygomatic breadth, 47 mm.; length of nasals, 37 mm.; width of nasals at base, 18.5 mm.; postorbital constriction, 14 mm.; length of supraorbital process, 18 mm.; alveolar length of upper molar series, 19.5 mm.; length of lower jaw exclusive of incisors, 69 mm.; depth of lower jaw, 45 mm.

It is surprising to find an apparently undescribed hare in the Maritime Province. However, the specimen from the Monoma River differs

sufficiently well in cranial characters from *L. t. gichiganus* and from *L. t. orii* from Sakhalin, its nearest allied species, to be recognized as a distinct form. Lack of comparative material from Lake Baikal makes it difficult to determine its exact relationship to *L. t. transbaikalicus* Ogneff. In the type description of the Transbaikalian form the skull is represented as smaller than *gichiganus* and the teeth are apparently correspondingly smaller, whereas in the Monoma specimen the skull is equally smaller than *gichiganus*, but the teeth are definitely larger; furthermore, the two localities are widely separated and conditions are so diversified that a marked difference would be expected.

Lepus t. mordeni in some respects appears to be intermediate between *L. t. gichiganus* and *L. mantschuricus* and approaches the latter in the size of the lower incisor teeth, development of reëntrant angles on anterior surface of upper premolars, roundness of the bullae, and shape of the supraorbital process. The skull, however, is heavier and resembles the *timidus* group in more general characters.

The one specimen secured was taken in the "taiga" on a well-beaten rabbit track at the side of a small stream. Further trapping here yielded no additional specimens and no other tracks were seen in the vicinity. Local hunters seemed to consider the white hare quite rare, and I saw no evidence of its fur being used for clothing by the natives.

***Sus scrofa ussuricus* Heude**

Ussuri Wild Boar

Sus ussuricus HEUDE, 1896, Mem. Conc. l'Hist. Nat. de l'Emp. Chin., III, p. 190.

Two specimens: Mukhen and Alche River District, 1 adult male; Amur River, near Troitskov, 1 female.

The Ussuri species is equal to, if not the largest, race of wild boar found in Europe and Asia. In external appearance it agrees more or less with the description of typical *Sus scrofa* of western Europe. Color of a semi-adult female in winter pelage from near Troitskov: upperparts mixed warm buff and black, the longest coarse hairs black, shorter coarse hairs black at base and liberally tipped with warm buff; on the shoulder the hair in the mid-line is longer, forming a stiff mane; chin blackish brown, an indistinct white line from behind angle of mouth to throat; underparts with black hairs tipped with pale buff or whitish and without all-black hairs. There is an abundant growth of brownish gray woolly under hair throughout the pelage. An adult male from the Mukhen River is much darker than the female; the buffy hairs on back are tipped

with black and all black hairs predominate; sides of body, limbs and snout blackish brown, underparts very little paler.

Measurements: skull, adult male, greatest length from occipital plane to anterior end of nasals, 420 mm.; length along top of skull in a straight line, 445 mm.

Wild boars were not uncommon in suitable localities visited in eastern Siberia and probably form the principal food of the tiger in that region. I did not see the large male secured by the expedition before it was skinned, but from all accounts it was an enormous brute.

***Moschus moschiferus parvipes* Hollister**

Korean Musk-deer

Moschus parvipes HOLLISTER, 1911, Proc. Biol. Soc. Wash., XXIV, pp. 1-2.

Three immature specimens: Monoma River.

The Korean musk-deer is a small, spotted, dark-colored, hornless deer with long brittle hair in winter pelage. The males have long slender canine teeth in upper jaw. According to Hollister, *M. m. parvipes* is smaller than typical *M. moschiferus*, the legs are relatively short and slender, feet small, with smaller main and lateral hoofs. Color of Monoma series in winter pelage: upperparts dark mummy-brown mixed with warm buff and indistinctly spotted with warm buff; the spots are arranged in more or less irregular transverse rows, most distinct on the posterior part of back and hips, linked together on the shoulders. Top of head from nose to nape mixed dark mummy-brown; cheeks and ears paler brown and white, a white streak from below eye to throat, another white streak from below ear joins white of throat at side of neck and extends backward to shoulders; sides of body dark mummy-brown; underparts mixed brown and white; limbs dark brown; inside of fore limbs and front of hind limbs with a streak of brown and white. Flerov, in his study of the genus *Moschus*, based on the extensive material in Russia, stated that the skull (145.4 mm.) of *M. m. parvipes* is smaller than that of typical *M. m. moschiferus*, occupying an intermediate place between the musk deer of Siberia and that of Sakhalin. The metacarpals (126.5 mm.) and the metatarsals (167.4 mm.) are shorter and finer than in *M. m. moschiferus*. The type locality for *M. m. parvipes* is the mountains near Mok-po, Korea. Flerov extends the range of this species north to the Ussuri district and as far as the mouth of the Amur. Three specimens from the Monoma River, one male and two females, are too young to show any very definite specific cranial characters and provisionally are referred to this species.

***Cervus xanthopygus* Milne-Edwards**

Manchurian Wapiti

Cervus xanthopygus MILNE-EDWARDS, 1867, Ann. Soc. Nat., VIII, p. 376; 1871, 'Recherches Mamm.,' p. 181, Pl. xxi.

One skull without skin: Mukhen and Alche River District.

In general appearance the Manchurian wapiti differs from other known forms in the shortness and stoutness of the horns and uniformly lighter and grayer coloration. In winter pelage the body is grayish brown, washed with chestnut, more intense on neck and forehead. Muzzle brown, darkening toward tip; no white on chin. Legs gray-brown, slightly darker on the anterior surface; a distinct brown mid-dorsal line, most pronounced on neck; summer pelage red or chestnut.

Measurements, skull of an old male from Mukhen and Alche River District: greatest length, 435 mm.; greatest breadth, 185 mm.; antlers, tines 5+5, length of outside curve, 29 inches. Measurements of a pair of horns from thirty miles east of Bikin: tines 5+5, length of outside curve, 28¾ inches; greatest spread, 24½ inches.

Tracks of Manchurian wapiti were common in the forested regions visited east of Bikin. North of Khabarovsk they were not so abundant and none were seen in the region east of Troitskov, which may have been purely a coincidence.

Unfortunately, I was not able to save a specimen that had apparently been killed by a tiger east of Bikin. Only a small portion was eaten, but it was frozen hard and too far from camp to attempt to move it.

SOME NORTH AMERICAN DIPTERA

By C. H. CURRAN

In this paper, descriptions are given of four apparently undescribed species, together with keys to genera and new synonymy. The types are in The American Museum of Natural History.

Dolichopidæ**Gymnopternus** Loew

During recent years this genus has been considered a synonym of *Hercostomus* Loew or at most a subgenus. Originally it was based upon the non-convergence of the third and fourth longitudinal veins, a character that has been found to be unsatisfactory in some instances, since some of the species are difficult to place. However, there is a supplementary character found in the presence of short, fine hairs on the hypopleura above the hind coxae, and I now regard *Gymnopternus* as quite distinct from *Hercostomus*, which lacks these hairs. Previously I had accepted the synonymy of the two genera.

No satisfactory key for the separation of the species exists, and this is considered sufficient justification for the publication of the one that follows. In its preparation I have had available a large number of species determined by Mr. Van Duzee, and I have every reason to suppose that the identifications are correct since he has examined the Loew types. A few of the described species are not available, and it is possible that more satisfactory characters could be found for the separation of some species. The matter is further complicated because the females of some forms are unknown, so that in many cases only the males can be identified with any degree of certainty.

During the preparation of the key, the synonymy of three species came to light, as follows.

***Gymnopternus nigribarbus* Loew**

Loew, 1861, 'Neue Beitr.,' VIII, p. 35.

G. phyllophorus Loew, 1866, Berl. Ent. Zeitschr., X, p. 45.

There can be no doubt that these two names represent the two sexes of one species. *G. nigribarbus* was described from the female and *phyllo-*

phorus from the male. The species is common and widely distributed in the eastern United States and Canada.

***Gymnopternus californicus* Van Duzee**

VAN DUZEE, 1920, Proc. Calif. Acad. Sci., X, p. 48.

Hercostomus vanduzeei CURRAN, 1930, Can. Ent., LXII, p. 287.

A comparison of specimens of *californicus* from Colorado, determined by Van Duzee, with the types of *vanduzeei* proves that the two names apply to the same species.

***Gymnopternus scotias* Loew**

LOEW, 1861, 'Neue Beitr.,' VIII, p. 29.

Hercostomus (Gymnopternus) browni VAN DUZEE, 1933, Amer. Mus. Novit., No. 599, p. 18.

Types of *browni* agree exactly with specimens of *scotias* Loew. Van Duzee compared *browni* with *tristis* Loew, but failed to connect the long pubescence on the third antennal segment with the similar condition prevailing in *scotias*. *G. scotias* is widely distributed in the north from Manitoba eastward and is recorded from as far south as New Jersey.

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 Face with stout, short hairs below; anterior four tibiae yellow.
tibialis Van Duzee.
- 40.—Face of male black, of female with fine pale hairs below. . . *nigrifacies* Van Duzee.
 Face whitish pollinose (females unknown). 41.
- 41.—Tarsi wholly blackish from tip of first segment; posterior tibiae wholly black except on the basal third above (Colorado). *brevipes* Van Duzee.
 Tarsi paler, the posterior tibiae more extensively reddish (North Carolina).
tenuicauda Van Duzee.
- 42.—Third antennal segment elongate (in the female short) and with long pubescence (*browni* Van Duzee). *scotias* Loew.
 Third antennal segment short and with inconspicuous pubescence in both sexes. 43.
- 43.—Face with short black hairs below; genital lamellae mostly black. . .
barbatulus Loew.
 Face of male without black hairs below. 44.
- 44.—Face of male black or brown. 45.
 Face of male whitish. 46.
- 45.—Genital lamellae yellow. 49.
 Genital lamellae black; posterior tarsi wholly black. *tristis* Loew.
- 46.—Genital lamellae black; length about 4 mm. 50.
 Genital lamellae mostly yellowish; length about 3 mm. . . *ovaticornis* Van Duzee.
- 47.—Hair and bristles black; male genitalia and ovipositor black; third antennal segment of male rounded apically. *maculiventris* Van Duzee.
 Hair yellow, the bristles black; male genitalia and ovipositor yellow; third antennal segment of male sharply pointed. *flavus* Loew.
- 48.—Posterior femora with black apical band. *annulatus* Van Duzee.
 Posterior femora wholly yellowish. 51.
- 49.—Posterior tarsi wholly black. *singularis* Van Duzee.
 Posterior tarsi yellow, becoming dark apically. *flavitaris* Van Duzee.

- 50.—Genital lamellae crescent-shaped with a truncate protuberance at the middle.
robustus Van Duzee.
 Genital lamellae crescent-shaped, without protuberance. *nigricoxa* Van Duzee.
- 51.—Posterior tarsi usually brownish almost to their base; the genital lamellae crescent-shaped; face of female with whitish hairs below.
obtusicauda Van Duzee.
 Posterior tarsi only slightly darkening apically in ground color; genital lamellae strongly convex apically; face of female bare, without hairs below.
frequens Loew.
- 52.—Face of male brownish, of female brown above. *chalcochrus* Loew.
 Face of male white. *vernaculus* Van Duzee.

CAMPSICNEMUS Walker

KEY TO MALES

- 1.—Middle tibiae not or scarcely swollen. 2.
 Middle tibiae with at least the basal half swollen, often greatly enlarged. 5.
- 2.—Middle tibiae mostly or wholly black and somewhat flattened. 3.
 Middle tibiae yellowish, not flattened. 4.
- 3.—Femora mostly yellow (Colorado). *arcuatus* Van Duzee.
 Femora mostly black (California). *nigripes* Van Duzee.
- 4.—Last section of fourth vein with brownish spot; front tarsi simple (widespread).
degener Wheeler.
 Last section of fourth vein without spot; basal segment of front tarsi very short and with an appendage more than half as long as the tarsus (Alaska, Ontario, Maine). *americanus* Van Duzee.
- 5.—Middle tibiae moderately thickened on the basal half, not greatly deformed (widespread). *hirtipes* Loew.
 Middle tibiae greatly thickened and deformed. 6.
- 6.—Middle tibiae with a strong, narrow lobe on the anterior surface near the apex. 7.
 Middle tibiae without such lobe. 8.
- 7.—Legs entirely metallic green and black; lobe of middle tibia not widened apically. *vanduzeei*, n. sp.
 Legs mostly reddish; lobe of middle tibia widened apically. *philoctetes* Wheeler.
- 8.—Basal segment of the middle tarsi U-shaped (Wyoming). *thersites* Wheeler.
 Basal segment of the middle tarsi not U-shaped. 9.
- 9.—Front coxae mostly blackish; middle tibiae with long bristles dorsally and ventrally (Maine). *wheeleri* Van Duzee.
 Front coxae mostly reddish; middle tibiae without long bristles on the dorsal surface except at the apex (western). *claudicans* Loew.

KEY TO FEMALES¹

- 1.—Legs wholly blackish. 2.
 Femora or tibiae mostly reddish. 3.
- 2.—(California). *nigripes* Van Duzee.²
 (Hudson Bay). *vanduzeei*, n. sp.²

¹*C. arcuatus* Van Duzee is omitted.

²Females of these species are unknown.

- 3.—All the femora blackish, with the apices broadly reddish; last section of fourth vein with conspicuous brown spot. *oedipus* Wheeler.
Femora mostly reddish, at least one pair almost entirely reddish or the last section of the fourth vein without strong brown spot. 4.
- 4.—Antennae wholly black. 5.
Basal antennal segment broadly yellow below. *americanus* Van Duzee.
- 5.—Last section of fourth vein with scarcely a trace of brown spot near basal fourth. 6.
Last section of fourth vein with distinct brownish spot near basal fourth. 7.
- 6.—Front coxae wholly yellowish. *hirtipes* Loew.
Front coxae at least broadly blackish basally on outer surface. 10.
- 7.—Hair and bristles of front coxae yellow. *degener* Wheeler.
Bristles of front coxae black. 8.
- 8.—Front coxae wholly yellow. *claudicans* Loew.
Front coxae broadly black basally, at least on the outer surface. 9.
- 9.—Mesonotum with violaceous reflections; spot on fourth vein strong.
wheeleri Van Duzee.
Mesonotum without violaceous reflections; spot on fourth vein weak.
philoctetes Wheeler.
- 10.—Front coxae all blackish. *thersites* Wheeler.
Front coxae mostly reddish, at least on the inner half. *philoctetes* Wheeler.

***Campsicnemus vanduzeei*, new species**

Similar to *philoctetes* Wheeler but with wholly blackish legs. Length, 2 mm.

MALE.—Front shining blackish green, bluish below; occipital hair black. Face very narrow, brown pollinose, shining green immediately below the antennae. Palpi dark brown, with black hair. Antennae brown; third segment small, subcordate, the arista sub-basal.

Thorax bronze-black, in some lights strongly metallic, the dorsum thinly brown pollinose; pleura brownish gray. Scutellum with bluish reflections.

Legs blackish, the middle tibiae green. Anterior and posterior legs simple, the middle tibiae enormously enlarged. Middle femora with a row of numerous, short black bristles on either edge of the lower surface. Middle tibiae very broad, widest at the basal third, toward the posterior edge with a row of four erect bristles on the apical two-thirds, the bristle nearest the apex weak; behind the upper bristle with a weaker one and on the apical fourth of the posterior edge with a row of quite short, weak bristles; beyond the middle close to the anterior edge with a low swelling bearing a cluster of very short bristles and in front of these on the median third with three or four fine bristles; beyond the setose swelling the tibia is rather deeply excavated and a flat, apically rounded process projects forward at the apical end of the concavity, while the apex of the tibia is angularly produced in front. The color of the tibia changes near the middle to bronze and near the apex to brown, the anterior and apical lobes being brown; the basal third is convex and hairy above, the dorsal surface beyond this more or less concave and glabrous except as noted. First segment of the middle tarsi rather strongly concave above, at the base with a small shining black tubercle, the apex produced as a shining black lobe to beyond the middle of the second segment; along the upper surface just in front of the middle with a thin,

moderately high ridge extending from the basal third of the segment almost to the apex of the lobe, and in front of this on a much lower level a row of short, contiguous hairs; behind, the segment bears a row of six or seven moderately long, fine bristles. Second segment practically simple, perhaps slightly shorter than the third.

Wings with brown tinge. Knob of halteres yellow.

Abdomen dark greenish, thinly brown pollinose, the venter more grayish. Genitalia small, the appendages with short white hair.

Types.—Holotype, male, and paratype, male, Churchill, Manitoba, August, 1932 (V. E. Shelford).

***Campsicnemus crassitibia* Van Duzee**

VAN DUZEE, 1930, Amer. Mus. Novit., No. 439, p. 1.

The type of this species is before me and an examination proves that it is not a *Campsicnemus* but belongs to *Peleropeodes* Wheeler and is a synonym of the species described by Van Duzee as *Kophosoma brevis*.

Ephydridae

***Diclasiope frontalis*, new species**

Front opaque black; face and lunule silvery white, the orbits brownish and cinereous. Length, 2.5 to 3 mm.

FEMALE.—Front opaque black, the middle broadly brownish in some lights; two pairs of frontals, the upper pair strong and divergent, the anterior pair weaker and proclinate; ocellars of moderate length, the postocellars long; verticals and outer verticals long. Occiput brownish pollinose; cheeks grayish, with a strong bristle behind. Face with a row of bristles on either side and a row of hairs immediately outside, the hairs not easily seen in some views; about four of the bristles strong. Proboscis and palpi brown; antennae black.

Thorax black, moderately brown pollinose, the pleura and metanotum with gray shading; three pairs of dorsocentrals, one situated in front of the suture; two pairs of scutellars and a hair on either side; one sternopleural.

Legs blackish; trochanters and immediate knees rather dull reddish; apices of the tibiae and the tarsi reddish, the apical tarsal segment brownish. Middle femora with an incomplete row of short bristles above.

Wings cinereous hyaline, the veins pale brownish; posterior cross-vein slightly recurrent, almost straight. Squamae brownish red. Halteres sulphur yellow.

Abdomen black, rather shining, thinly brownish pollinose, the venter with more evident, paler pollen.

Types.—Holotype, female, Natashquan, Quebec, August 1, 1929. Paratypes: two females, Thunder River, Quebec, August 19, 1930, all collected by W. J. Brown. The holotype is in the Canadian National Collection.

Superficially this species is remarkably like *Hydrellia formosa* Loew, but the presence of the spine on the second antennal segment distinguishes it and it evidently belongs to *Diclasiope*. However, the known species of *Diclasiope* evidently have only two pairs of dorsocentrals,

so the species may differ generically. The face is quite as in *Hydrellia* except for the secondary row of hairs on the sides.

EPHYDRA Fallén

A key to the Nearctic species of this genus is given herewith in the hope that it may assist in the determination of the species. It is by no means certain that the number of species included in the key should be recognized, since it is possible that some of them represent color varieties. Some of the species possess very distinct genital characters in the males, while others show less evident differences. The males of *salina* Curran and *hians* Say have very similar genitalia but there are some small differences that are apparently constant, and these, together with color differences, and other structural characters of more or less importance appear to indicate that two species are involved. This same condition apparently exists in the case of *millbrae* Jones, *pectinulata* Cresson, and *niveiceps* Cresson, although there is always the possibility that the male genitalia will prove to be quite distinct in these species. The color of the legs is fairly constant, but not always so, as Aldrich has found specimens of *millbrae* with wholly reddish legs. The front tarsi of the males are usually somewhat modified, in some cases having an elongate, shallow groove posteriorly near the base, in others being shortened or bearing distinctive groups of hairs.

TABLE OF SPECIES

- 1.—Five pairs of dorsocentrals.....3.
Six pairs of dorsocentrals.....2.
- 2.—Face deep cinnamon-brown.....*salina* Curran.
Face grayish or brownish yellow.....*hians* Say.
- 3.—Femora blackish or green with at most the apices or bases reddish.....4.
Femora much more extensively reddish.....*subopaca* Loew.
- 4.—Posterior cross-vein directed at least slightly toward the apex of the wing, the discal cell longer in front.....5.
Posterior cross-vein recurrent, the discal cell shortest in front.....*gracilis* Packard.
- 5.—Tibiae more than half yellowish or reddish.....9.
Tibiae more or less reddish basally, but blackish or greenish on apical two-thirds or more.....6.
- 6.—Tarsi bright yellow.....*auripes* Aldrich.
Tarsi blackish, brownish, or with reddish bases.....7.
- 7.—Posterior cross-vein very oblique and sinuate.....*hians* Say.
Posterior cross-vein slightly oblique and almost straight.....8.
- 8.—Front, from anterior view, wholly brown pollinose.....*obscuripes* Loew.
Front, from anterior view, with only the sides and a median vitta brownish.
austriana Coquillett.

- 9.—Face rich, brownish yellow.....*millbrae* Jones.
 Face cinereous white or white.....10.
- 10.—Occipital cilia developing into two or three stout bristles near the oral margin.
pectinulata Cresson.
- Occipital cilia developing only a single strong bristle close to the oral margin..11.
- 11.—Tarsi wholly blackish; mesonotum brown.....*obscuripes* Loew.
 Tarsi reddish with dark apices.....*niveiceps* Cresson.

Tetanoceridae

RENOCERA Hendel

The following key separates the Nearctic species.

TABLE OF SPECIES

- 1.—Front with two pairs of bristles.....2
 Front with a single pair of bristles in addition to the ocellars.....4.
- 2.—Cheeks nearly as wide as the eye-height.....3.
 Cheeks half as wide as the eye-height.....*pacifica*, n. sp.
- 3.—Third antennal segment subquadrate; posterior cross-vein recurrent.
quadrilineata Melander.
- Third antennal segment oval, twice as long as wide; posterior cross-vein transverse.....*johnsoni* Cresson.
- 4.—Arista loosely plumose or pubescent.....5.
 Arista densely plumose to the tip; third antennal segment tapering to the rounded apex.....*longipes* Loew.
- 5.—Arista short pubescent; no shining stripe along the line of the frontal bristle.
brevis Cresson.
- Arista short plumose; front with shining stripes laterally.....6.
- 6.—Apical two tarsal segments black; mesonotum not vittate; cheeks one-fourth as wide as the eye-height.....*amanda* Cresson.
- Apical tarsal segment black; mesonotum vittate, cheeks one-half as wide as the eye-height.....*cyathiformis* Melander.

Renocera pacifica, new species

Differs from both *quadrilineata* Melander and *johnsoni* Cresson in having only the apical segment of the front tarsi black and much narrower cheeks. Length, 6 mm.

FEMALE.—Head yellowish, the face, lower half of the cheeks and narrow frontal orbits white pollinose, the occiput, ocellar triangle and lateral frontal stripes with dull ochreous pollen. Front, measured from the base of the verticals to the anterior margin, wider than long, the sides gently converging anteriorly; lateral and median frontal stripes brownish in ground color, the median one narrow and extending almost to the anterior margin, slightly wider near the ocelli and with a slight whitish sheen, the front dull; two frontal bristles on either side, the hair rather sparse; ocellars, post-ocellars and the verticals and outer verticals strong. Occiput with a white spot on either side above the neck; hair black; a row of three fine bristles below running from a point near the neck to the oral margin. Cheeks half as wide as the eye-height, with short hairs on the lower half. Proboscis reddish; palpi yellowish, with fine hairs

basally and bristly hairs on the apical half, the hair sparse except basally. Antennae dark orange; third segment mostly brownish on the outer side, oval, about one-half longer than wide; arista black, short plumose to the tip.

Thorax luteous, the mesonotum with six narrow brown vittae, the median pair abbreviated in front and widening posteriorly, the sublateral pair abbreviated in front and behind and interrupted at the suture, the lateral pair lying above the root of the wings and extending narrowly above the notopleura almost to the humeri. Mesonotum with luteous or dull ochraceous pollen, the pleura with cinereous pollen on the lower half, rather ferruginous above. Two pairs of dorsocentrals; sternopleura haired but without bristles; mesopleura and pteropleura bare. Scutellum brownish red, with pale border, the disc with fine hairs; four marginal bristles.

Legs reddish, the apical segment of the tarsi black; anterior femora with a row of four anterodorsal bristles on the apical third, the posterior pair with a row of two or three on the apical fourth; middle femora with only the single anterior bristle near the apical third.

Wings rather luteous, becoming grayish posteriorly, the cross-veins bordered with brown. Squamae cinereous white, with pale yellow fringe. Halteres yellow.

Abdomen rusty reddish, the disc somewhat darkened, moderately shining and thinly reddish-brown pollinose; fifth segment with two or three bristles apically on the sides.

HOLOTYPE.—Female, Boiler Bay, Oregon, May 18, 1930 (J. Wilcox).

Muscidae

Megaphthalma Becker

BECKER, 1894, Berl. Ent. Zeitschr., XXXIX, p. 105.

In North America there are three species belonging to this genus. The genotype is *Cordylura pallida* Fallén.

TABLE OF SPECIES

- | | |
|---|--------------------------------|
| 1.—Scutellum with four strong marginals..... | 3. |
| Scutellum with a single pair of marginal bristles..... | 2. |
| 2.—Mesonotum with four strong, brown vittae..... | <i>pallida</i> Fallén. |
| Mesonotum with scarcely a trace of vittae..... | <i>americana</i> Malloch. |
| 3.—Face opaque blackish, the front usually of the same color in the male; first vein setulose apically..... | <i>wilcoxi</i> , n. sp. |
| Face yellowish in ground color; first vein wholly bare.... | <i>unilineata</i> Zetterstedt. |

Megaphthalma pallida Fallén

Cordylura pallida FALLÉN, 1819, 'Dipt. Suec.,' Scatomyzidae, p. 8.

This species agrees well with *americana* Malloch, but the mesonotum is mostly black, the dark vittae sometimes being fused. I know of no American records.

Megaphthalma americana Malloch

MALLOCH, 1924, Pan-Pac. Ent., I, p. 14.

Originally described from Oregon, Washington, Idaho, and Pennsylvania, I have examined specimens from the following localities: Megantic, Quebec, June (Curran); Keremeos, British Columbia, June (C. Garrett); Bashbish Falls, Mass., June, Chester, Mass., August, and Glen House, New Hampshire, July (C. W. Johnson); and Electric Lake, Colorado, June 28-30, 1919 (F. E. Lutz).

Megaphthalma unilineata Zetterstedt

Cordylura unilineata ZETTERSTEDT, 1838, 'Ins. Lapon.,' p. 727.

Male and female, Low Bush, Ontario, August (N. K. Bigelow); female, Flinsberg, Germany. I have also seen specimens from Alaska.

Megaphthalma wilcoxi, new species

A very striking species in the male sex owing to the deep black face and front, although the front is rarely but little darkened. Distinguished in both sexes by the presence of two pairs of scutellar bristles and the setulose first vein. Length, 4.25 to 5.5 mm.

MALE.—Reddish yellow except parts of the head. Front normally opaque black, except along the orbits above, the parafrontals whitish, the whole front with a whitish sheen when seen from in front; five pairs of frontals, the anterior two convergent, middle pair proclinate, the upper two divergent; ocellars long, the outer verticals about half as long as the verticals; occiput with black bristly hair above and fine pale hair below. Cheeks one-third as wide as the eye-height, mostly dull black, with whitish sheen. Face dull black, with whitish sheen from some views. Proboscis yellowish, more or less brown apically; palpi yellow, with some short, coarse black hairs apically. Antennae dull black, the basal segments reddish; arista short pubescent. In one specimen the face and front are brownish instead of black, the color becoming brownish red on the upper part of the front.

Mesonotum with yellowish, the pleura with whitish pollen; four to six dorso-centrals, the acrostical hairs in two or three irregular rows. Scutellum with two pairs of hairs in addition to the four bristles. Propleura haired; a single strong sternopleural; prothoracic and stigmatic bristles present.

Legs wholly pale, the hair yellow except on the tarsi, the bristles black.

Wings cinereous hyaline, the veins luteous, becoming yellow basally. Squamae and fringe pale yellowish. Halteres yellow.

Abdomen shining, with rather long, whitish hair. Genitalia large, the outer forceps with a very large, hemicircular emargination on the inner side.

FEMALE.—Face, front, and cheeks wholly pale in ground color. Apices of the abdominal segments narrowly blackish except on the middle of the dorsum, the tip of the ovipositor black.

TYPES.—Holotype, male, allotype, female, and six paratypes (males), Aneroid Lake, Blue Mts., Oregon, 7500 ft., July 23, 1929 (H. A. Scullen), received from Mr. J. Wilcox.

